VALIDATING A FOOD FREQUENCY QUESTIONNAIRE FOR GUAM

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And whatever you do, whether in word or deed, do it all in the name of the Lord Jesus, giving thanks to God the Father through him.
-Colossians 3:17

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Aloha

Part 1. Background

1. Diet: A risk factor for disease

Typically, many cultures have some sort of set beliefs regarding the effects of food on one's body. While these values have been passed from generation to generation, it is only a more recent occurrence for formal epidemiological studies to be conducted on the validity of these beliefs [1]. Nutritional epidemiology, the study of the relationship between nutrition and health, stems from the interest in the concept that there exists a relationship between diet and disease [2]. With diet being a difficult exposure to measure in observational research studies, identifying associations between diet and disease in homogeneous populations is difficult due to insufficient variation [1]. For many years, various studies have attempted to shed more light on diet's role in health and disease by improving the methodology for nutritional epidemiological studies. One focus in these studies includes evaluating a person's daily nutrient intake as a variable of interest. Nutrient density, a ratio of a nutrient value to total caloric intake, is another variable of interest since it is a convenient way to describe diet [2].

This thesis will report the development, analyses, and results of the reproducibility and validation studies for the Guam Food Frequency Questionnaire (FFQ). Emphasis on the statistical tools used in this study will be explained in greater detail, especially how statistics relates to and is applied to nutritional epidemiological studies such as these.

2. Dietary instruments

2.1. **Food Records.** Diet records contain open-ended data where respondents are asked to record all foods and amounts of foods consumed over a set period of time [3]. Participants are trained in advance on the proper methods for accurately completing a food record. During a set period of time that is determined by the researcher, a participant records the type and quantity of foods consumed immediately before or after consumption in order to minimize having to rely too much on the participant's recall memory. Food amounts are recorded as either weights or as standard household measurements (e.g., cups, tablespoons, teaspoons). A completed food record must immediately be reviewed by a nutritionist or a trained research assistant in order to be sure there is an adequate amount of detail provided by the participant [2].

Utilizing food records saves time for researchers since interviews are necessary only in the event clarification is needed. Not having to rely on a participant's memory is another benefit. A couple drawbacks are that a participant may not be as thorough in detailing food preparation and may not be as accurate in measuring amounts of food. Also, a participant's eating habits may temporarily change at the time of keeping a food record because the participant knows that s/he is being actively assessed.

2.2. **24-Hour Recalls.** A 24-hour dietary recall is another dietary tool where participants are asked to recall the type and quantity of foods and drinks consumed during the past day or previous 24-hour period [2]. A trained research assistant or a nutritionist interviews the participant and records all foods consumed.

An interview allows the researcher to ask probing questions in order to solicit specific data at a greater level of detail. As a result, data from a 24-hour recall can contain specific and accurate information because a trained interviewer would know how to ask all the right questions. A substantial drawback is that the data is only as reliable as a participant's ability to accurately remember all foods and amounts of foods consumed within the past 24 hours.

2.3. **FFQs.** In epidemiological studies, evaluating nutrition as a factor is most commonly done by means of a food frequency questionnaire [2]. A FFQ is a dietary instrument that assesses long-term dietary intake of a specific population. Since FFQs are culturally and ethnically sensitive, validation and reproducibility FFQ studies need to be conducted each time a tailored FFQ is used for a new target population [2].

A drawback to utilizing a FFQ is that, compared to open-ended data formats such as diet records and recalls, a participant is not able to be as specific about food consumption, food preparation, and food amounts [2]. Another drawback is that the FFQ solicits information on dietary intake over a less precisely defined set of time [2]. On the other hand, processing data from a FFQ can be faster and, therefore, more cost-effective for a study.

3. Validation & Reproducibility

The term *validity* is defined to be the degree to which the questionnaire measures the dietary aspect that it was designed to measure [2]. On the other hand, *reproducibility* demonstrates the consistency of questionnaire measurements after repeated administrations of a FFQ to the same person at different times [2].

In our particular case, a validation study of a FFQ demonstrates how reliable this dietary tool is in its ability to rank nutrient intake of individuals on Guam. The Guam FFQ must first be tested for its validity and reproducibility before being able to render the tool as usable in later epidemiological studies. Generally, validation studies measure one instrument against another instrument that is considered to be a "gold standard." However, very few gold standards exist for diet, namely the biomarkers doubly labelled water for energy and urinary nitrogen for protein. These biomarkers are prohibitively expensive and allow study of only 2 nutrients. Therefore, using diet records is considered to be an acceptable alternative "gold standard" of measurement.

Part 2. Guam

4. BRISK project

According to the most recent report of Guam Cancer Facts and Figures 2003 - 2007, Guam's breast cancer incidence rate is the highest of all cancer incidence rates for women on Guam at 76.2 cases per 100,000 persons, age-adjusted to the 2000 U.S. standard population. Among all reported mortality rates for Guam, breast cancer is a close second only to lung and bronchial cancer. The risk of breast cancer is substantial for Chamorro (the indigenous people of Guam) women with the second highest incidence rate after lung cancer [4] and the highest mortality rate [5].

No epidemiological or clinical studies have been done on breast cancer risk factors for Guamanians to date [6]. However, there is at least one full project underway that is funded by a National Institutes of Health, National Cancer Institute grant to the University of Guam (UOG) Cancer Research Center in joint partnership with the University of Hawai'i (UH) Cancer Center. Co-Investigators Drs. Rachael Leon Guerrero (UOG), Rachel Novotny (UH), Lynne Wilkens (UH), and Suzanne Murphy (UH) are conducting a research project called the *Development of a Breast Cancer Risk Model for the Pacific* (also known as BRISK).

The purpose of this study is to conduct a retrospective case-control study with 100 cases and 200 controls. A case-control study is a type of observational study where researchers gather a set of participants who have the disease (the *cases*) and a set of participants who do not (the *controls*) [7]. Data obtained from this case-control study are used to build a breast cancer risk model that will add modifiable health behaviors and obesity, along with well-accepted risk factors (eg. the "Gail" model) in breast cancer development, among Asian-Pacific women of the Mariana Islands. The study will also establish an understanding of breast cancer in the Mariana Islands in relation to lifestyle and create new opportunities for further research in the Pacific.

In order to develop this model, researchers created an extensive dual quantitative and qualitative BRISK questionnaire that captures information to evaluate demographic risk factors, known breast cancer risk factors, and a variety of other risk factors. Diet is included as among one of the aforementioned "variety of other risk factors."

5. Development of Guam FFQ

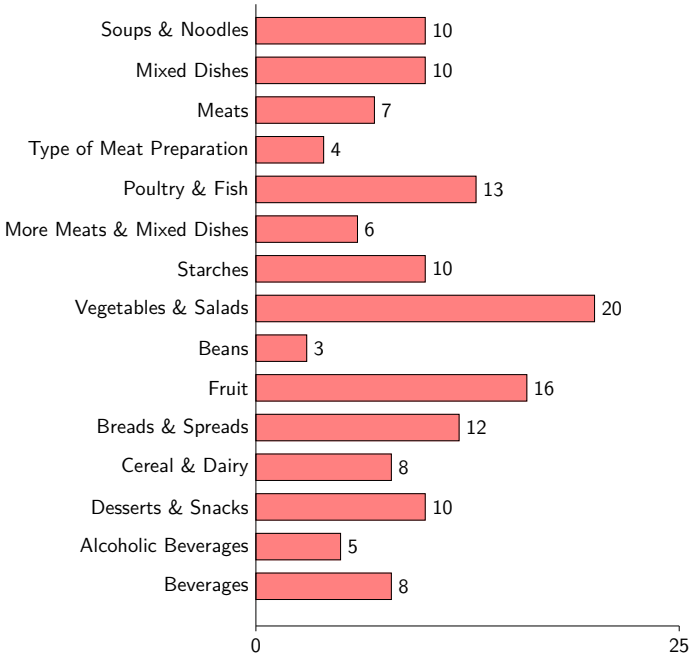
The basis of dietary guidance for the creation of this Guam FFQ was from a 2004 UOG Cancer Research Center cross-sectional study of Chamorro ($n = 66$) and Filipino ($n = 61$) adults living on Guam who were between the ages of 25-65 years. Participants completed a 24-hour dietary recall which helped reveal some of the commonly consumed foods on Guam. The

sampling procedures for this study are described in detail in another article [8].

Guam's self-administered 15-paged, 142-item quantitative FFQ was created by first using Hawai'i's Multiethnic Cohort (MEC) quantitative FFQ as a reference questionnaire [9]. Additional food items were included in Guam's FFQ after identifying commonly consumed foods from a 2004 study that entitled *Diet and Obesity among Chamorro and Filipino adults on Guam* [8]. Most of the 142 items in the FFQ are aggregated food items rather than individual foods. Figure 1 is a bar graph that shows the frequency of food items per food groupings (e.g., *processed meats* versus *hotdogs* alone).

FFQ data contain serving sizes and frequencies of each aggregated food item rather than individual foods (see Appendix D for a blank copy of the Guam FFQ). Food items listed in the Guam FFQ are comprised of foods that are grouped together by similarity and comparable nutrient composition. Only few food items listed in the Guam FFQ are comprised of only one food (e.g., "white rice" is listed by itself).

FIGURE 1. Food Groupings on the Guam FFQ



6. Validation Study: Design

For the validation study, researchers obtained participants by means of convenient sampling. Dr. Rachael Leon Guerrero surveyed friends of her UOG students, UOG staff members, and friends and relatives of those UOG

staff members. While sampling for this study, a balanced number of participants from across the age groups was intentionally recruited. Twenty-two of the 58 participants were less than 24 years of age , 15 participants were 24–35 years old, and 21 participants were older than 35 years. Fourteen participants in this validation study were post-menopausal women participating in the BRISK pilot study who completed an entire BRISK questionnaire along with a FFQ and a 24-hour dietary recall. All participants in the validation study first completed a FFQ and then completed a diet record/recall within the following 5 days [9]. Prior to completing a diet record, participants were instructed by a trained research assistant on the process of correctly completing a diet record. Completed diet records were reviewed upon completion for accuracy by a trained research assistant and a registered dietician [9]. Thirty-six of the 58 participants completed a 2-day diet record. Two-day diet records were required in order to establish within person and between person variances and adjust for day-to-day variation.

Three participants of the validation study were not recorded in the data due to not having completed both a dietary recall and a Guam FFQ. The choice for 400 kcal/day to be our cut off for the study is arbitrary, yet acceptable, since a general acceptable range is usually 500–3,500 kcal/day for women and 800–4,000 kcal/day for men [2]. Due to the relatively small sample sizes for both studies, it makes sense to be a bit more forgiving with the ranges in order to minimize excluding too many participants, while also taking measurement error into consideration. Using total energy intake in order to identify outliers in our sample population is a supported practice in these type of studies since energy is the only intake that is physiologically fixed within a narrow and predictable range [2].

7. Reproducibility Study: Design

Researchers gathered data from 58 participants by means of convenience sampling for a reproducibility study. Dr. Rachael Leon Guerrero tasked her UOG Spring 2007 nutrition students to seek participants. Students were given Guam FFQs and were assigned to ask a family member or friend to complete the questionnaire. In order to avoid having only those in their early twenties complete the questionnaire, Dr. Leon Guerrero made it clear that the student should try his or her best to get someone who is an older relative or friend to participate. Participants completed a Guam FFQ during April 2007, and then they completed a second Guam FFQ four weeks later in May 2007.

Research assistants managed data entry. The same data were entered twice into Excel spreadsheets and then compared to check for accuracy. All studies were approved by each of University of Hawai‘i’s and University of Guam’s Institutional Review Boards [9].

8. Nutrient Computation

In March 2010, I was hired by the University of Hawai‘i Cancer Center (UHCC) Epidemiology Department under Dr. Lynne Wilkens and joined the Biostatistics core. The Biostatistics core, led by Dr. Wilkens and Dr. Grazyna Badowski (UOG), provides statistical consultation and support for projects that are funded by the UOG-UH joint research grant. With the assistance of the BRISK team and with a great deal of help from Dr. Wilkens, I completed majority of the work that is described in the remainder of this thesis.

8.1. **Guam Food Composition Table: Development.** Nutrient intake data from the validation study's diet records were computed by the Pacific Tracker (PacTrac) Program, 4th edition. The PacTrac program is an online dietary assessment tool that was based on a program developed by the USDA called Tracker for nutritional assessment and modified for use in the Pacific Islands by including the food composition data from the University of Hawai‘i Cancer Center which includes local foods [10]. As of 2008, eighty-five recipes of foods commonly consumed on Guam were added to the UHCC database to allow PacTrac to be relevant for Guam-based dietary analysis studies [11]. Since then, more Guam recipes have been added to the UHCC database during further development of the Guam FFQ validation study.

8.2. **Nutrient Computation.** In order to use a completed FFQ to assess nutrient intake for an individual, a food composition table must first be constructed. A food composition table displays the amounts of each nutrient per 100 grams of food for each food item. The database for the PacTrac program was used to gather information for nutrient composition for each of the individual foods composes a FFQ food item. Converting data from FFQs to nutrient intake values is especially useful for epidemiological purposes of examining relationships between nutrient intake and health outcomes.

Amounts of nutrients per 100 grams of each of the aggregated food items on the FFQ were computed as the weighted average of amounts of its constituent foods. We first used the 24-hour dietary recall data from the 2004 study of 127 Guamanians as a source of commonly eaten foods. Each individual food from the recall data along with its associated frequency was assigned into its appropriate Guam FFQ food item category. This was done so as to create a preliminary list of individual food weights per food item. Dr. Rachael Leon Guerrero, a registered dietician, then made appropriate adjustments and additions to the food weights list in order to make accommodations for commonly consumed foods on Guam that may not have been adequately (if at all) represented in the 2004 study.

Nutrient information for each individual food represented in the revised list was obtained by accessing the University of Hawai‘i Cancer Center food database. The food composition table resulted after computing weighted averages of all individual foods listed for each FFQ food item.

In order to compute daily nutrient intake per person, serving sizes for each FFQ food item first needed to be converted into grams in order to convert them to nutrients, as the food composition table gives amounts of nutrients per 100 grams of food. Using the MEC FFQ food as a reference, if a MEC FFQ food item was similar to a corresponding Guam FFQ item, then the gram weight for each serving size from the MEC item was used for the Guam food item's gram weight. Any Guam FFQ food items that could not be linked to a MEC FFQ food item were assigned gram weights by Dr. Leon Guerrero.

Frequency per food item was converted into times per day by dividing the corresponding monthly frequency by 30.4 (See Table 1). Grams consumed per day per food item were then computed by multiplying the gram weight by the daily frequency for each food item. Nutrient information for each food item per person was computed by taking the product of grams consumed per day per food item and nutrient component per 100 grams of food item and then scaling the product by a factor of 100. Total nutrient consumption per day was computed by taking the sums of each nutrient across all food items within person.

Table 1. Conversion Table.

Category	Times per day
Never (<1/mo)	0
Once a month	1/30.4
2–3x a month	2.4/30.4
Once a week	4.3/30.4
2–3x a week	10.3/30.4
4–6x a week	21.7/30.4
Once a day	1
2 or more a day	2

9. Statistics

9.1. **Spearman's Correlation Coefficient.** In 1904, English psychologist Charles Spearman proposed the Spearman correlation coefficient (also known as Spearman's ρ) in the American Journal of Psychology [12]. Spearman aimed at quantifying the strength of two associated variables in psychology experiments by creating a non-parametric version of the Pearson correlation that would measure monotone association rather than Pearson's measure of linear association.

Pearson's product-moment correlation coefficient for two quantitative approximately normally distributed variables X and Y is calculated as the covariance divided by the square root of the product of variances:

$$r = \frac{\sum_i (X_i - \overline{X})(Y_i - \overline{Y})}{\sqrt{\sum_i (X_i - \overline{X})^2}\sqrt{\sum_i (Y_i - \overline{Y})^2}} \tag{1}$$

Pearson's r is a bounded measure of association between X and Y since $-1 \leq r \leq 1$, where r only takes on its extreme values only in "degenerate" cases of $r = \pm 1$ when the data are exactly linear and $r = 0$ when there is no linear association [13].

Pearson's r does have some drawbacks with respect to this dietary study. For one, its value is not as reliable if the distributions are not approximately normal and there exist extreme values, as these outliers can significantly influence the value of r. Another drawback to Pearson's r is that this coefficient measures linear association rather than monotonic association. Spearman's ρ has the same formula of Pearson's r with the ranks for X (numbered from 1 to n in descending order) and the ranks for Y substituted for the respective X and Y values.

Based on [14], SAS computes Spearman's ρ by using Equation 2.

$$\rho = \frac{\sum_i (r(X_i) - r(\overline{X}))(r(Y_i) - r(\overline{Y}))}{\sqrt{\sum_i (r(X_i) - r(\overline{X}))^2}\sqrt{\sum_i (r(Y_i) - r(\overline{Y}))^2}} \tag{2}$$

where $r(X_i)$ =rank(X_i) and $r(Y_i)$ =rank(Y_i).

Spearman's ρ is not affected by outliers in the observed values, and ρ measures monotone association rather than strict linear association. Like r, ρ is also bounded by ± 1 since $(\sum ab)^2 \leq \sum a^2 \sum b^2$ by the Cauchy-Schwartz inequality [15]. Positive correlation in the extreme sense ($\rho = 1$) represents perfect agreement in that the larger the X value, then the larger its corresponding Y value is. On the other hand, negative correlation ($\rho = -1$) represents perfect disagreement in that the larger the X value, then the smaller its Y value. If there is no correlation between X and Y, then Spearman's ρ tends towards 0.

Different statistical books present different versions of Spearman's ρ, with equations 2 and 3 being two of the most commonly reported versions. Assuming no ties for ranks are present, an equivalent expression for ρ is as follows:

$$r_S = 1 - \frac{6\sum_i d_i^2}{n(n^2-1)} \text{ where } d_i = r(X_i) - r(Y_i). \tag{3}$$

Proof. Given n observations, where $X_i \neq X_j$ and $Y_i \neq Y_j$ for all $i \neq j$, we have

$$r(\overline{X}) = r(\overline{Y}) = (1+2+3+...+n)/n = \frac{1}{2}(n+1),$$
$$\sum_{i=1}^{n} r(X_i) = \sum_{i} r(Y_i) = 1+2+3+...+n = \frac{1}{2}n(n+1) \text{ and}$$
$$\sum_{i=1}^{n} [r(X_i)]^2 = \sum_{i} [r(Y_i)]^2 = 1^2+2^2+3^2+...+n^2 = \frac{1}{6}n(n+1)(2n+1).$$

Thus, $\sqrt{\sum_{i=1}^{n}(r(X_i)-r(\overline{X}))^2} = \sqrt{\sum_{i=1}^{n}(r(Y_i)-r(\overline{Y}))^2}$.
Thus,

$$\begin{aligned}
\rho &= \frac{\sum_{i=1}^{n}(r(X_i)-r(\overline{X}))(r(Y_i)-r(\overline{Y}))}{\sqrt{\sum_{i=1}^{n}(r(X_i)-r(\overline{X}))^2}\sqrt{\sum_{i=1}^{n}(r(Y_i)-r(\overline{Y}))^2}} \\
&= \frac{\sum_{i=1}^{n}(r(X_i)-r(\overline{X}))(r(Y_i)-r(\overline{Y}))}{\sum_{i=1}^{n}(r(X_i)-r(\overline{X}))^2} \\
&= \frac{\sum_{i=1}^{n} r(X_i)r(Y_i) - \sum_{i=1}^{n} r(X_i)r(\overline{Y}) - \sum_{i=1}^{n} r(Y_i)r(\overline{X}) + \sum_{i=1}^{n} r(\overline{X})r(\overline{Y})}{\sum_{i=1}^{n}(r(X_i)-r(\overline{X}))^2} \\
&= \frac{\sum_{i=1}^{n} r(X_i)r(Y_i) - \left[\frac{1}{2}n(n+1)\right]\left[\frac{1}{2}(n+1)\right] - \left[\frac{1}{2}n(n+1)\right]\left[\frac{1}{2}(n+1)\right] + n\left[\frac{1}{2}(n+1)\right]^2}{\frac{1}{6}n(n+1)(2n+1) - 2\left[\frac{1}{2}n(n+1)\right]\left[\frac{1}{2}(n+1)\right] - n\left[\frac{1}{2}(n+1)\right]^2} \\
&= \frac{\sum_{i=1}^{n} r(X_i)r(Y_i) - \frac{1}{4}n(n+1)^2}{\frac{1}{6}n(n+1)(2n+1) - \frac{1}{4}n(n+1)^2} \\
&= \frac{12\sum_{i=1}^{n} r(X_i)r(Y_i) - 3n(n+1)^2}{2n(n+1)(2n+1) - 3n(n+1)^2} \\
&= \frac{12\sum_{i=1}^{n} r(X_i)r(Y_i) - 3n(n+1)^2}{n(n^2-1)} \\
&= \frac{12\sum_{i=1}^{n} r(X_i)r(Y_i) - n(n+1)[-(n-1)+2(2n+1)]}{n(n^2-1)} \\
&= \frac{12\sum_{i=1}^{n} r(X_i)r(Y_i) + n(n^2-1) - 2n(n+1)(2n+1)}{n(n^2-1)} \\
&= 1 - \frac{6\left[-2\sum_{i=1}^{n} r(X_i)r(Y_i) + \frac{1}{3}n(n+1)(2n+1)\right]}{n(n^2-1)}.
\end{aligned}$$

Since

$$\begin{aligned}\sum_{i=1}^{n}(d_i)^2 &= \sum_{i=1}^{n}[r(X_i)-r(Y_i)]^2 \\ &= \sum_{i=1}^{n}[r(X_i)]^2 - 2\sum_{i=1}^{n}r(X_i)r(Y_i) + \sum_{i=1}^{n}[r(Y_i)]^2 \\ &= \frac{1}{6}n(n+1)(2n+1) - 2\sum_{i=1}^{n}r(X_i)r(Y_i) + \frac{1}{6}n(n+1)(2n+1) \\ &= \frac{1}{3}n(n+1)(2n+1) - 2\sum_{i=1}^{n}r(X_i)r(Y_i),\end{aligned}$$

we have the desired result. □

Utilizing Spearman's ρ is widely accepted to measure agreement in reproducibility and validation studies. Using ranks may seem like a less accurate method of expressing the relationship between variables since we cannot always determine how close or how far $(r(X_i), r(Y_i))$ is from $(r(X_j), r(Y_j))$ for $i \neq j$. However, what is lost in accuracy is gained in generality since correlations remain ranking invariant under stretching and shrinking [15].

All correlations reported in the results section of this paper were done by SAS 9.2 programming. We can use the following data as an easy example to help see how ρ can be calculated by hand. The data presented in Table 2 is a subset consisting of all males represented in the reproducibility study.

TABLE 2. Data for Spearman's ρ example.

FFQ1	FFQ2	Rank(FFQ1)	Rank(FFQ2)	$(d_i)^2$
1400.48	1343.42	10	11	1
1359.38	1388.89	11	10	1
2216.55	1866.55	7	9	4
2038.09	2191.38	9	8	9
2504.30	2567.64	5	6	1
2205.82	2949.51	8	3	0
2953.38	3730.19	2	2	0
3045.07	5807.17	1	1	0

One can observe that $\sum_i d_i^2 = 30$ and $n = 11$. Thus,

$$\rho = 1 - \frac{6(30)}{11(120)} = 0.86.$$

It is easy to see how this process could take a very long time if each correlation for each nutrient for each study were to be done by hand. However,

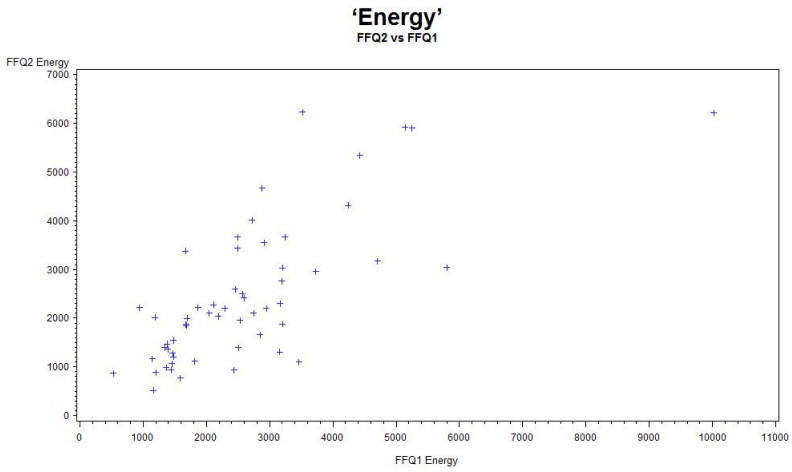
it is a worthwhile task to go through such a procedure in order to better appreciate the ease and importance of utilizing a statistical software tool such as SAS. One might also observe that this correlation is different than what is reported in the results section ($\rho = 0.82$), and that is because the correlations in the results section were adjusted for age and race.

Another example for using Spearman's ρ and identifying an example of a possible systematic between-person error (discussed in section 9.4) is as follows: correlations for energy adjusted nutrients were not performing as one would expect based on the trends from similarly structured past studies. This was an issue for both the reproducibility and the validation studies, but it was especially troublesome to see such poor energy adjusted correlations for the reproducibility study.

In an effort to determine the source behind the poor correlations, Dr. Lynne Wilkens suggested we look at the following graphs for the reproducibility study. We evaluated the following three scatter plots, as shown in Figures 2, 3, 4.

The first graph in Figure 2 shows the crude energy intake per participant, with the energy intake from the first FFQ on the x-axis and the energy intake from the second FFQ on the y-axis. One can directly observe that it seems to be sufficiently correlated. This is confirmed with $\rho = 0.71$.

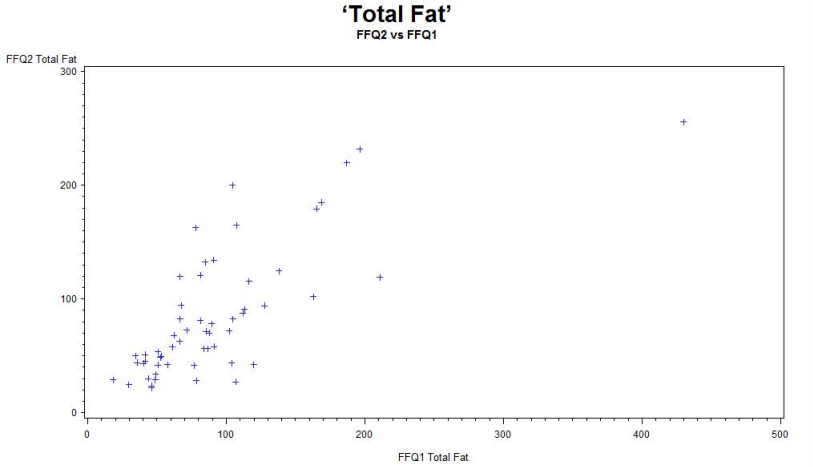
FIGURE 2. *Reproducibility Study*



The second graph in Figure 3 is the total fat intake per person in the reproducibility study. The ordered pair (x, y) is the reported fat intakes from the first FFQ and the second FFQ, respectively. Notice, again, that the distribution is well correlated with $\rho = 0.71$.

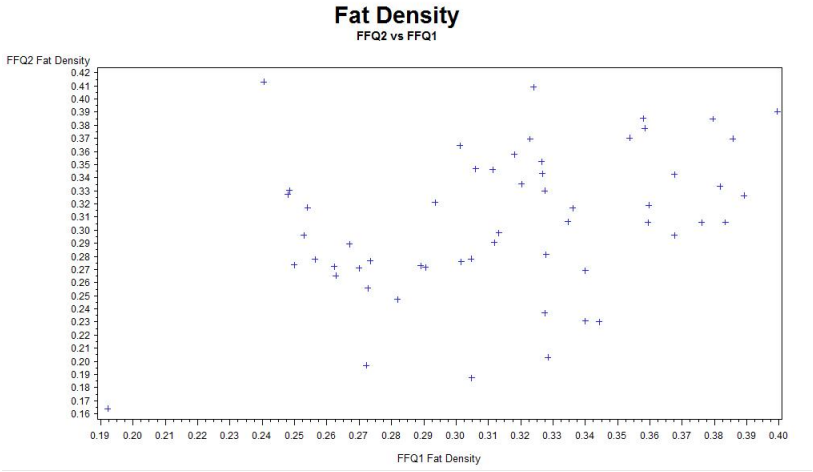
Fat intake is strongly correlated with energy intake [2]. Of all nutrients, fats have the greatest food energy per mass (9 kcal/g) and, therefore, is

FIGURE 3. *Reproducibility Study*



a large contributor to total energy intake. Figure 4 displays a graph of fat density (total fat/total calories) per person in the reproducibility study. The ordered pair (x, y) is the fat density from the first and second FFQs per person, respectively. It is here where we come across the problem where energy and fat intakes are individually well-correlated, but the ratio is not correlated with $\rho = 0.34$.

FIGURE 4. *Reproducibility Study*



While the graphs did not lead us to a definite solution to the problem, it was still helpful to see where the correlations went awry. Dr. Lynne Wilkens

hypothesizes that one source of this problem may be due to the representation of saturated fat in the FFQ. This may be due to an underreporting of the consumption of processed meats or the underreporting of the consumption of foods containing coconut milk. Even though the list of foods under each FFQ food item is not exhaustive, perhaps the FFQ did not mention a highly consumed processed meat under one of the FFQ food items. Also, perhaps the participant did not consider a key food that s/he highly consumes when reporting intake for a particular food item. Another plausible explanation may be a misrepresented food weight in our creating a food composition table for the FFQ.

It is noteworthy to point out the outlier that can be seen in each of the top right corners of Figures 2 and 3. While it might be worthwhile to eliminate this participant for having an unusually high energy intake, it is easy to see that this one outlier is not the cause of the overall problem. It is easy to see that Spearman's ρ is not too sensitive to this particular outlier since this participant has a high ranking for both FFQs, resulting in a minimal difference of ranks. Also, this outlier is certainly not the cause for the poorly correlated fat density distribution in Figure 4.

9.2. **Cross Classification.** Contingency tables (cross classification) are an alternative method of analysis for presenting data on the associations between the FFQ and diet records [2]. In this validation study, categories were defined by quartile cut-off points. Cross classification provides the opportunity to assess the extent of misclassification per nutrient by reporting the proportion of values that fell into the same quartile, adjacent quartiles, quartiles that are one apart from each other (e.g., a participant's reported energy intake on the FFQ belonging to the first quartile while that same participant's reported energy intake on his/her diet record falling into the third quartile), or opposite quartiles (gross misclassification). Cross classification results for the validation study are seen in Table 4.

9.3. **Bland-Altman Plots.** Bland-Altman plots measure validity by assessing relative agreement between two methods that measure the same continuous variable on the same scale [16]. These scatter plots compare two methods of measurements per subject per nutrient by plotting a participant's difference of the two scores on the y axis by the mean of the two scores on the x axis. Additional reference lines appear in Bland-Altman plots such as the mean of differences and confidence intervals ($0 \pm 1.96 SD_{diff}$), where SD_{diff} is the standard deviation of the differences. Bland-Altman plots, shown in Figures 5, 6, 7, and 8 are created by using log-transformed nutrient values to increase normality [2].

9.4. **Variability Correction.** Random and systematic errors are two general types of error that can be observed within person and between persons. Random within person error occurs in FFQ studies due to day-to-day fluctuating in diet. However, the mean of repeated measures of diet tends towards

the true value and minimizes this error. Random between person error results from only having one measurement per participant along with the presence of random within person error. Random between error also occurs when there is systematic random within person error randomly distributed among all participants in a study [2].

Systematic within person error happens when a participant fails to identify on a FFQ a food s/he commonly consumes (but not necessarily a common food for the entire population). Given the food consumption trends for the population of interest, a commonly consumed food that is not appropriately identified on an FFQ can be a source of systematic between person error [2]. Systematic error is substantially more difficult to measure compared to random error.

Error correction is modeled by

$$z = x + \epsilon \tag{4}$$

where x is the true measure of exposure, z is the surrogate measure that contains random measurement error ϵ [2].

We use equation 5 in order to adjust correlations for within person variability.

$$r_t = r_o\sqrt{1 + \lambda/n} \tag{5}$$

where r_t is the true correlation; r_o is the observed correlation; $\lambda = (s_w)^2/(s_b)^2$, the ratio of within- and between-person variances obtained by intraclass correlations; and n is the number of replicates per person [2].

In order to compute for r_t for correlations for the validation study, Dr. Wilkens computed factors (of the form $\sqrt{1 + \lambda/n}$) for 6 variable types (r_o): original, sex/race/age adjusted, logged, density, and energy adjusted. Since our current sample size is not sufficiently large nor is it a sufficiently homogeneous population, and with only 36 two-day food records, the estimates are not considered to be stable enough to create factors for each of the 6 variables separately. Therefore, the median factor is used as the factor across all 6 variable types. In the event that the median factor is greater than 3, the minimum factor is used instead.

10. Validation Results

Correlations are adjusted for age, sex, and race for the validation study and for sex and race in the reproducibility study. Spearman's correlations for absolute nutrients ranged from 0.24 for polysaturated fat to 0.72 for sodium with a mean of 0.46.

Participants in the validation study averaged 2,147 kcal/day for energy intake for the 1- to 2-day diet records and 2,647 kcal/day for the Guam FFQ. For the reproducibility study, participants averaged 2,577 kcal/day for energy intake for the first FFQ and 2,365 kcal/day for the second FFQ.

The following tables report Spearman's ρ coefficients for both log transformed nutrients and densities. ICC values, a cross-classification table, and

Bland-Altman plots were also computed for the validation study. Nutrients in the validation study were adjusted for age, sex, and race, and nutrients in the reproducibility study were adjusted for sex and race. Although measures were taken to assure that most of the participants in the reproducibility study would be older than 30 years of age, the participants were not asked to report their ages, which is why age adjustments were not possible for the reproducibility study. Additional tables reporting correlations for various subgroups of the studies are listed in Appendix A.

TABLE 3. *Validation Study* ($n = 58$). Corrected correlations between 1- to 2-day diet records and Guam FFQ for selected nutrients among all participants in the validation study.

	Correlation Assessment Methods		
Dietary Variables	Spearman's ρ^*	Spearman's ρ for Densities†	ICC*
Energy (kCal)	0.55		0.10
Protein(g)	0.34	0.34	0.17
Total Fat(g)	0.56	0.48	0.39
Saturated Fat(g)	0.41	-0.05	0.23
Mono Fat(g)	0.30	0.52	0.19
Poly Fat(g)	0.17	0.58	0.15
Chol(mg)	0.20	0.23	0.03
Carbohydrate(g)	0.49	0.26	0.26
Calcium(mg)	0.69	0.30	0.36
Phosph(mg)	0.67	0.44	0.28
Magnes(mg)	0.44	0.26	0.19
Iron(mg)	0.78	0.02	0.00
Sodium(mg)	0.94	0.45	0.51
Potass(mg)	0.51	0.09	0.12
Zinc(mg)	0.55	0.16	0.37
Thiamin(mg)	0.81	0.31	0.73
Riboflavin(mg)	0.71	0.15	0.68
Niacin(mg)	0.33	-0.08	0.00
VitB-6(mg)	0.59	0.32	0.00
VitB-12(mcg)	0.35	0.08	0.00
VitC(mg)	0.47	0.07	0.97
Dietary Fiber (g)	0.72	0.23	0.27

* correlations based on log transformed values for sex, age, and race
† correlations adjusted for sex, age, and race

TABLE 4. *Validation Study* $n = 58$. Cross classification[‡](%) of intake of selected nutrients between 1- to 2-day diet records and Guam FFQ among all participants in the validation study.

Dietary Variables	Same Quartile	Adjacent Quartile	One Quartile Apart	Opposite Quartiles
Energy(kcal)	36	29	26	9
Protein(g)	41	31	17	10
Total Fat(g)	31	36	24	9
Saturated Fat(g)	31	33	28	9
Monounsaturated Fat(g)	31	34	26	9
Polyunsaturated Fat(g)	29	38	24	9
Cholesterol(mg)	33	40	19	9
Carbohydrate(g)	36	31	26	7
Calcium(mg)	45	41	10	3
Phosphorus(mg)	33	43	16	9
Magnesium(mg)	33	48	12	7
Iron(mg)	24	48	24	3
Sodium(mg)	31	38	26	5
Potassium(mg)	26	59	9	7
Zinc(mg)	38	33	21	9
Thiamin(mg)	36	36	19	9
Riboflavin(mg)	36	43	16	5
Niacin(mg)	29	38	22	10
VitB-6(mg)	33	40	19	9
VitB-12(mcg)	24	53	12	10
VitC(mg)	38	47	14	2
Fiber(g)	40	41	16	3
mean	33	41	19	7

[‡] Statistics based on instrument-specific cut-off points

FIGURE 5. Bland-Altman Plots

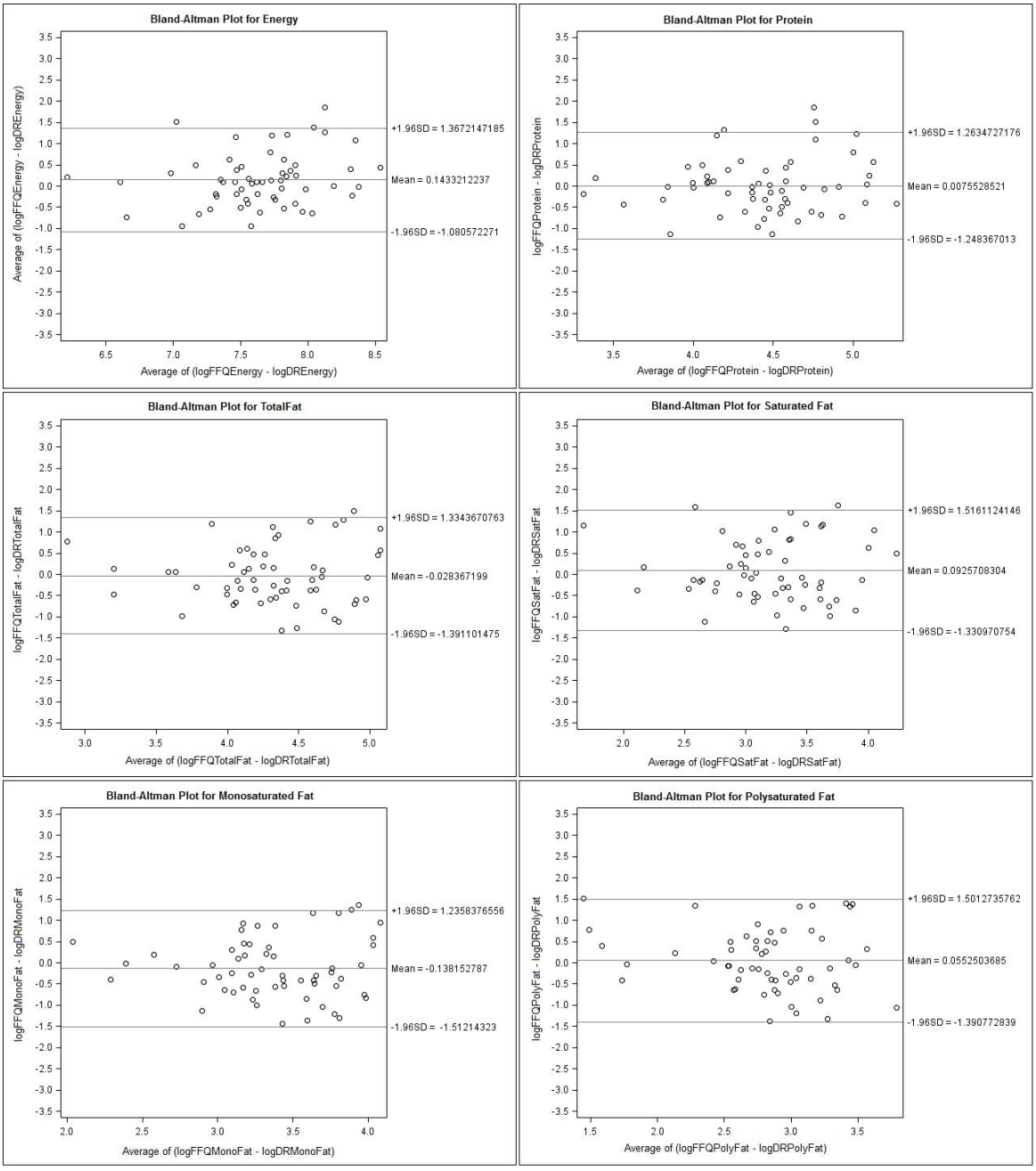


FIGURE 6. Bland-Altman Plots, cont'd

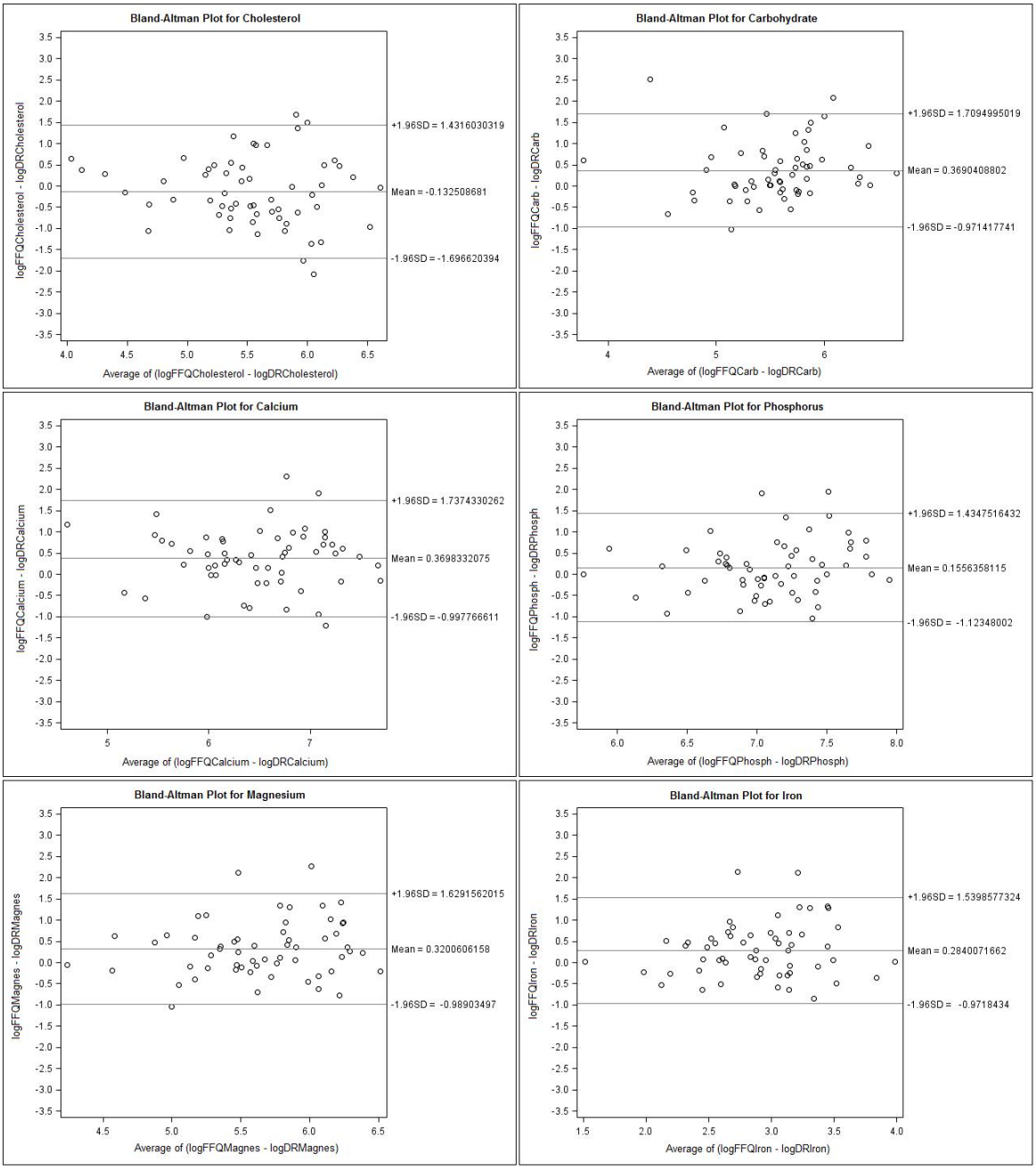


FIGURE 7. Bland-Altman Plots, cont'd

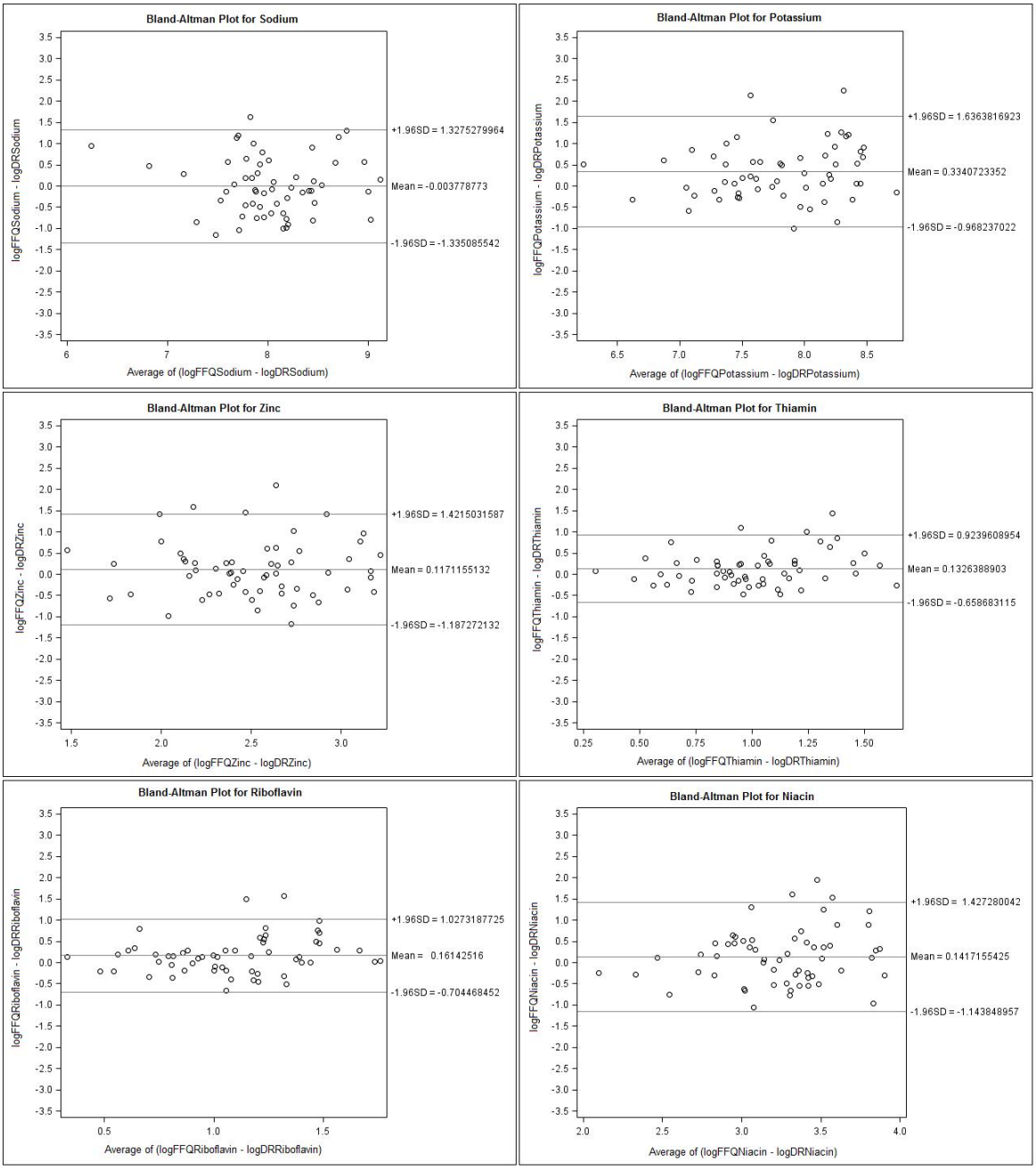


FIGURE 8. Bland-Altman Plots, cont'd

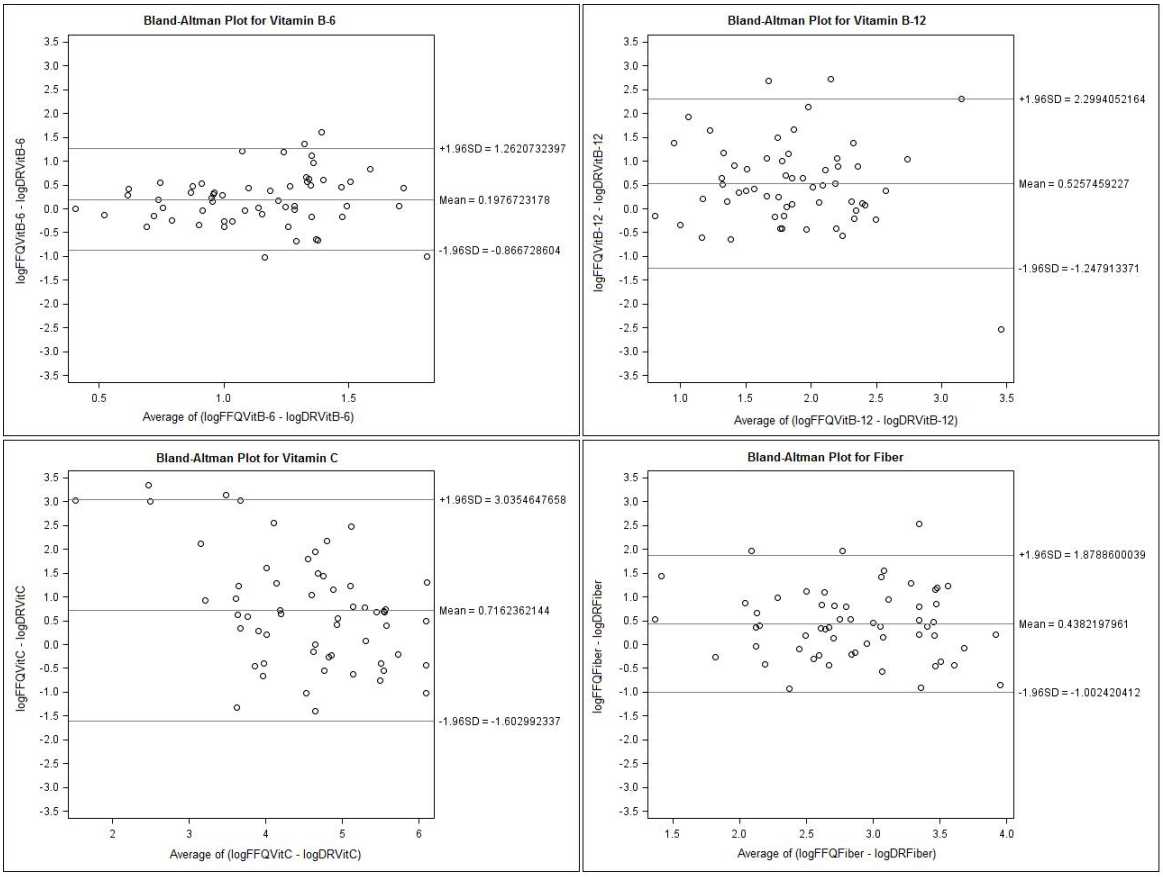


TABLE 5. *Reproducibility Study* ($n = 56$). Corrected correlations between pre- and post-FFQs for selected nutrients among all participants in the reproducibility study.

	Correlation Assessment Methods	
Dietary Variables	Spearman's ρ^*	Spearman's ρ for Densities†
Energy (kCal)	0.69	
Protein(g)	0.69	-0.02
Total Fat(g)	0.69	0.35
Saturated Fat(g)	0.70	0.39
Mono Fat(g)	0.69	0.22
Poly Fat(g)	0.70	0.26
Chol(mg)	0.71	0.15
Carbohydrate(g)	0.60	0.25
Calcium(mg)	0.72	0.56
Phosph(mg)	0.67	0.44
Magnes(mg)	0.66	0.64
Iron(mg)	0.66	0.55
Sodium(mg)	0.69	0.19
Potass(mg)	0.68	0.58
Zinc(mg)	0.66	0.34
Thiamin(mg)	0.66	0.69
Riboflavin(mg)	0.72	0.62
Niacin(mg)	0.65	0.37
VitB-6(mg)	0.67	0.68
VitB-12(mcg)	0.68	0.43
VitC(mg)	0.75	0.69
Dietary Fiber (g)	0.68	0.68

* correlations based on log transformed values for sex and race

† correlations adjusted for sex and race

11. Reproducibility Results

Two of the 58 participants were excluded from the reproducibility study and none of the 58 participants in the validation study due to having reported unusually low caloric intakes (<400 kcal/day) in either the diet record or the FFQ. Spearman's correlations for absolute nutrients ranged from 0.65 for carbohydrate to 0.75 for vitamin C and a mean of 0.70.

12. Conclusion

12.1. **FFQ Validation.** Correlations reported for the Guam FFQ validation study performed favorably and is comparable to other established, similarly conducted nutritional epidemiological studies such as MEC and Willett's 1988 Nurses' Health Study which evaluated reproducibility and validity for a 116-item FFQ with 150 participants. MEC reported that correlations for white females ranged from 0.38 for protein to 0.66 for vitamin C [17]. Correlations for the Nurses' Health Study had a mean of 0.50 and ranged from 0.28 for iron to 0.61 for carbohydrate [2]. While these correlations coefficients may seem to be low, validation studies typically range from 0.5 to 0.7 and are comparable to other validity tests conducted in other non-laboratory epidemiological population studies that have well-established a positive association between lifestyle and disease risk [2].

12.2. **FFQ Reproducibility.** Overall, correlations for the reproducibility study are within what would be considered to be an acceptable range. Most reproducibility studies usually have correlations that range between 0.5 to 0.7 [2]. After adjustments, the correlations for the reproducibility study ranged from 0.6 for carbohydrate to 0.75 for vitamin C with a mean of 0.68.

These results are comparable to Willett's 1988 Nurses' Health Study that had an average correlation of .53 with a range of .44 for carbohydrate to .62 for vitamin C [2]. Willett's *Nutritional Epidemiology* textbook reports results on 41 other completed reproducibility studies [2]. While reproducibility studies are still important in assessing a FFQ, it is uncommon nowadays to see published journal articles that report solely on a reproducibility.

12.3. **Limitations.** Due to the low number of Chamorro females surveyed ($n = 3$), there were insufficient data at present to present side-by-side correlation results with Filipino females ($n = 37$) in the reproducibility study. There were also a low number of Chamorro males surveyed ($n = 2$) for the reproducibility study.

12.4. **Future Research.** Data collection is still on-going for both the validation and reproducibility studies in order to have larger overall sample sizes. Efforts are taken to ensure the groups (such as males in both studies, Chamorro females in the reproducibility study) that initially had small sample sizes during the first round of sampling will now have a better representation in the final sample population. Since the SAS code is already written, the statistical analyses should be a relatively quick process after data entry. Upcoming results will be submitted for publication. [9].

Now that the Guam FFQ is rendered usable, we will now be able to use this dietary instrument in conjunction with the data from the BRISK questionnaire to create a breast cancer risk model for women on Guam. As more data are collected during the BRISK study, it would be helpful to conduct follow-up calibration studies for the Guam FFQ.

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Appendix A. Additional Tables

Table A.1. *Validation Study.* Corrected correlations between 1- to 2-day diet records and Guam FFQ for selected nutrients among males (left) and females (right) in the validation study.

	Correlation Assessment Methods			
	Males ($n = 14$)		Females ($n = 44$)	
Dietary Variables	Spearman's ρ^*	Spearman's ρ for Densities†	Spearman's ρ^*	Spearman's ρ for Densities†
Energy (kCal)	0.62		0.50	
Protein(g)	0.01	0.59	0.50	0.22
Total Fat(g)	-0.23	-0.50	0.76	0.73
Saturated Fat(g)	0.43	-0.22	0.37	0.05
Mono Fat(g)	-0.18	0.17	0.42	0.63
Poly Fat(g)	-0.29	0.62	0.35	0.56
Chol(mg)	0.32	0.09	0.19	0.26
Carbohydrate(g)	0.74	0.26	0.39	0.26
Calcium(mg)	0.76	0.28	0.71	0.34
Phosph(mg)	0.79	0.48	0.70	0.54
Magnes(mg)	0.38	0.31	0.51	0.22
Iron(mg)	0.28	0.05	0.97	-0.09
Sodium(mg)	1.00	-0.57	0.86	0.89
Potass(mg)	0.44	0.48	0.54	-0.12
Zinc(mg)	-0.14	0.14	0.78	0.16
Thiamin(mg)	0.79	0.37	0.88	0.15
Riboflavin(mg)	0.72	0.28	0.73	0.12
Niacin(mg)	-0.19	0.02	0.48	-0.21
VitB-6(mg)	0.41	0.51	0.70	0.20
VitB-12(mcg)	0.82	-0.05	0.31	0.19
VitC(mg)	0.30	0.26	0.54	0.01
Dietary Fiber (g)	0.77	0.73	0.69	0.07

* correlations based on log transformed values for sex, age, and race

† correlations adjusted for sex, age, and race

TABLE A.2. *Validation Study.* Corrected correlations between 1- to 2-day diet records and Guam FFQ for selected nutrients among males (left) and females (right) in the validation study.

	Correlation Assessment Methods			
	Males ($n = 14$)		Females ($n = 44$)	
Dietary Variables	Spearman's ρ^*	Spearman's ρ for Densities†	Spearman's ρ^*	Spearman's ρ for Densities†
Energy (kCal)	0.62		0.50	
Protein(g)	0.01	0.59	0.50	0.22
Total Fat(g)	-0.23	-0.50	0.76	0.73
Saturated Fat(g)	0.43	-0.22	0.37	0.05
Mono Fat(g)	-0.18	0.17	0.42	0.63
Poly Fat(g)	-0.29	0.62	0.35	0.56
Chol(mg)	0.32	0.09	0.19	0.26
Carbohydrate(g)	0.74	0.26	0.39	0.26
Calcium(mg)	0.76	0.28	0.71	0.34
Phosph(mg)	0.79	0.48	0.70	0.54
Magnes(mg)	0.38	0.31	0.51	0.22
Iron(mg)	0.28	0.05	0.97	-0.09
Sodium(mg)	1.00	-0.57	0.86	0.89
Potass(mg)	0.44	0.48	0.54	-0.12
Zinc(mg)	-0.14	0.14	0.78	0.16
Thiamin(mg)	0.79	0.37	0.88	0.15
Riboflavin(mg)	0.72	0.28	0.73	0.12
Niacin(mg)	-0.19	0.02	0.48	-0.21
VitB-6(mg)	0.41	0.51	0.70	0.20
VitB-12(mcg)	0.82	-0.05	0.31	0.19
VitC(mg)	0.30	0.26	0.54	0.01
Dietary Fiber (g)	0.77	0.73	0.69	0.07

* correlations based on log transformed values for sex, age, and race

† correlations adjusted for sex, age, and race

TABLE A.3. *Reproducibility Study.* Corrected correlations between pre- and post- FFQs for selected nutrients among males (left) and females (right) in the reproducibility study.

	Correlation Assessment Methods			
	Males ($n = 11$)		Females ($n = 45$)	
Dietary Variables	Spearman's ρ^*	Spearman's ρ for Densities†	Spearman's ρ^*	Spearman's ρ for Densities†
Energy (kCal)	0.82		0.69	
Protein(g)	0.77	0.40	0.67	-0.10
Total Fat(g)	0.79	0.29	0.68	0.35
Saturated Fat(g)	0.86	0.28	0.69	0.42
Mono Fat(g)	0.74	0.06	0.68	0.27
Poly Fat(g)	0.65	-0.49	0.69	0.39
Chol(mg)	0.98	0.45	0.68	0.08
Carbohydrate(g)	0.61	0.34	0.59	0.23
Calcium(mg)	0.49	0.28	0.74	0.66
Phosph(mg)	0.75	0.28	0.67	0.49
Magnes(mg)	0.60	0.16	0.67	0.70
Iron(mg)	0.89	0.64	0.63	0.51
Sodium(mg)	0.70	0.14	0.69	0.26
Potass(mg)	0.47	0.25	0.73	0.68
Zinc(mg)	0.86	0.26	0.64	0.37
Thiamin(mg)	0.74	0.79	0.65	0.67
Riboflavin(mg)	0.56	0.65	0.73	0.62
Niacin(mg)	0.76	0.54	0.64	0.37
VitB-6(mg)	0.65	0.75	0.68	0.67
VitB-12(mcg)	0.85	0.69	0.65	0.37
VitC(mg)	0.66	0.47	0.81	0.71
Dietary Fiber (g)	0.35	0.59	0.72	0.71

* correlations based on log transformed values for sex and race

† correlations adjusted for sex and race

TABLE A.4. *Validation Study.* Corrected correlations between 1- to 2-day diet records and Guam FFQ for selected nutrients among Chamorro females (left) and Filipino females (right) in the validation study.

	Correlation Assessment Methods			
	Chamorro Females ($n = 22$)		Filipino Females ($n = 19$)	
Dietary Variables	Spearman's ρ^*	Spearman's ρ for Densities†	Spearman's ρ^*	Spearman's ρ for Densities†
Energy (kCal)	0.36		0.65	
Protein(g)	0.38	0.01	0.60	0.57
Total Fat(g)	0.93	0.72	0.42	0.39
Saturated Fat(g)	0.60	-0.32	0.25	0.55
Mono Fat(g)	0.60	0.78	0.19	0.30
Poly Fat(g)	0.46	0.61	0.34	0.55
Chol(mg)	0.28	0.75	0.43	0.11
Carbohydrate(g)	0.37	0.37	0.41	0.09
Calcium(mg)	0.73	0.26	0.74	0.35
Phosph(mg)	0.80	1.00	0.56	-0.12
Magnes(mg)	0.50	0.16	0.54	0.30
Iron(mg)	0.76	-0.17	1.00	-0.01
Sodium(mg)	0.78	0.44	1.00	0.98
Potass(mg)	0.47	0.04	0.60	-0.28
Zinc(mg)	0.43	0.24	1.00	0.19
Thiamin(mg)	0.93	0.24	0.90	0.15
Riboflavin(mg)	0.63	0.16	0.91	0.04
Niacin(mg)	0.35	-0.71	0.49	0.18
VitB-6(mg)	0.99	0.01	0.39	0.33
VitB-12(mcg)	0.03	0.16	0.87	0.01
VitC(mg)	0.46	-0.01	0.65	-0.15
Dietary Fiber (g)	1.00	0.30	0.61	0.06

* correlations based on log transformed values for sex, age, and race

† correlations adjusted for sex, age, and race

TABLE A.5. *Reproducibility Study.* Corrected correlations between pre- and post- FFQs for selected nutrients for Filipino Females ($n = 36$).

	Correlation Assessment Methods	
Dietary Variables	Spearman's ρ^*	Spearman's ρ for Densities†
Energy (kCal)	0.65	
Protein(g)	0.66	-0.17
Total Fat(g)	0.65	0.20
Saturated Fat(g)	0.65	0.31
Mono Fat(g)	0.66	0.20
Poly Fat(g)	0.69	0.34
Chol(mg)	0.66	0.05
Carbohydrate(g)	0.58	0.14
Calcium(mg)	0.75	0.64
Phosph(mg)	0.64	0.42
Magnes(mg)	0.64	0.64
Iron(mg)	0.62	0.46
Sodium(mg)	0.68	0.19
Potass(mg)	0.70	0.61
Zinc(mg)	0.58	0.37
Thiamin(mg)	0.64	0.66
Riboflavin(mg)	0.72	0.61
Niacin(mg)	0.57	0.28
VitB-6(mg)	0.65	0.67
VitB-12(mcg)	0.68	0.38
VitC(mg)	0.80	0.69
Dietary Fiber (g)	0.71	0.68

* correlations based on log transformed values for sex and race

† correlations adjusted for sex and race

Appendix B. SAS Programming

Post data collection and data entry, the bulk of my time was spent using the statistical program Statistical Analysis System (SAS 9.2) to organize data and compute statistics. Processing this data manually, or even on an Excel spreadsheet, would have been a very long and arduous task. Simply stated, SAS 9.2 is a data set (similar to a structured spreadsheet) manipulation program that computes statistics and allows the user to organize and manage a data set's variables and the variables' observations from a small- to large-scale level.

Data for the studies were collected and compiled on Microsoft's Excel spreadsheet program. Then the Excel spreadsheets were imported and converted into SAS-compatible data sets. In Figure 9, a sample screenshot of a SAS program is shown. The left side bar contains several icons that are SAS spreadsheet files. The main section of the screen shows sample code that was written in the "Editor" tab of the program. Two other screens that are not shown in Figure 9 are the "Log" tab that displays a running log of how each part of the program performed and the "Output" tab that displays the outputs of any code that was executed.

Figure 9. A sample screen shot of SAS 9.2

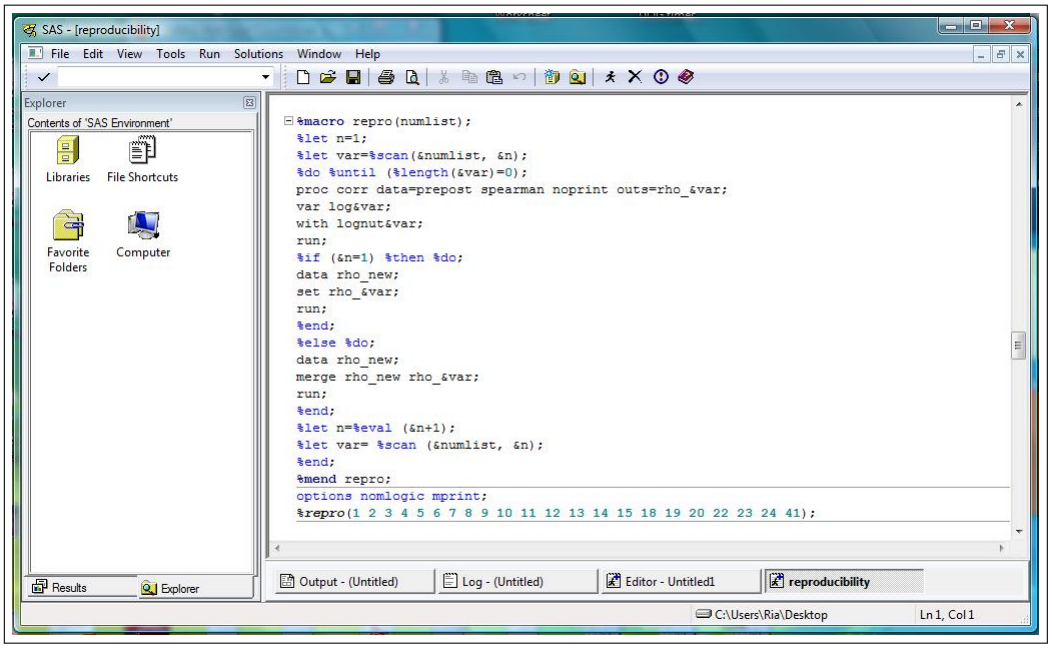


Figure 10 shown below gives sample code for computing Spearman's ρ. Much of the surrounding code that leads up to this point has been omitted. This sample uses the PROC CORR procedure in order to compute Spearman's rank correlation coefficient for the data set called "ffqrecall," which

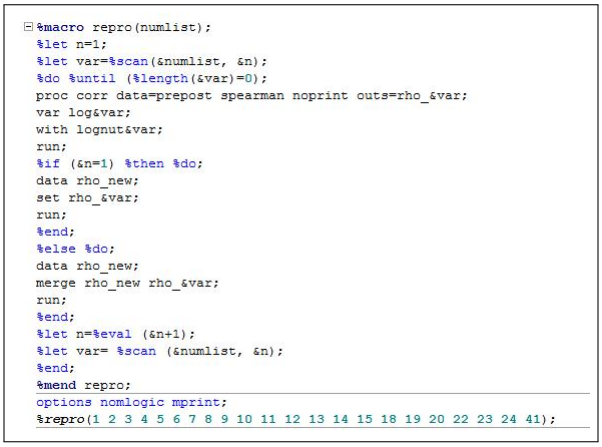
contains the variables "Energy " and "dailynut1." "Energy" is the variable name for the energy values for each person who completed a dietary recall in the validation study. "Dailynut1" is the variable name for the energy values for each person's corresponding energy values from his/her completed Guam FFQ. Each row of the SAS data set used to compute a data set used to compute the correlation coefficient contains one person's respective energy values from the diet record and the FFQ.

FIGURE 10. A sample screen shot of SAS 9.2

```
proc corr data=ffqrecall spearman;
var Energy;
with dailynut1;
run;
```

Oftentimes in this study, we will process many of the variables in the same fashion. The code in Figure 10 just computes Spearman's ρ for energy. Instead of having to write the above code repetitively for the other 21 nutrients, a favorable alternative would be to utilize macro variable programming in SAS. The "%" is indicative of using macro variable code in SAS. Figure 11 is a sample macro variable program used in the reproducibility study to compute Spearman's ρ for all 22 dietary components. Another example of macro variable code was used to start building Guam's Food Composition Table. By enumerating the variables that we want to process through this program, the numbers listed at the bottom of the code show which variables are to be processed through this macro variable program. The syntax is similar to that of general code, but there is a greater ease in using symbolic substitution to greatly reduce the code length so as to make the overall program more readable for a programmer.

FIGURE 11. Sample of SAS 9.2 code using macro variables



```
%macro repro(numlist);
 %let n=1;
 %let var=%scan(&numlist, &n);
 %do %until (%length(&var)=0);
 proc corr data=prepost spearman noprint outs=rho_&var;
 var log&var;
 with lognut&var;
 run;
 %if (&n=1) %then %do;
 data rho_new;
 set rho_&var;
 run;
 %end;
 %else %do;
 data rho_new;
 merge rho_new rho_&var;
 run;
 %end;
 %let n=%eval (&n+1);
 %let var= %scan (&numlist, &n);
 %end;
 %mend repro;
 options nomlogic mprint;
 %repro(1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 18 19 20 22 23 24 41);
```

FIGURE 12. Sample of SAS 9.2 code using macro variables

```
%macro foods(numlist);
 %let n=1;
 %let var=%scan(&numlist, &n);
 %do %until (%length(&var)=0);
 data guamnutrients_&var(keep= prodcode nutr_no&var);
 set fct.guamnutrients;
 if nutr_no=&var;
 nutr_no&var=nutr_val;
 run;
 proc sort data=guamnutrients_&var;
 by prodcode;
 run;
 %if (&n=1) %then %do;
 data guamnutrients_new;
 set guamnutrients_&var;
 run;
 %end;
 %else %do;
 data guamnutrients_new;
 merge guamnutrients_new guamnutrients_&var;
 by prodcode;
 run;
 %end;
 %let n=%eval (&n+1);
 %let var= %scan (&numlist, &n);
 %end;
 %mend foods;
 options nomlogic mprint;
 %foods(0002 0003 0006 0007 0008 0009 0010 0011 0018 0019 0020 0021 0022 0023 0024 0025
 0026 0033 0034 0035 0036 0037 0039 0040 0041 0044 0045 0046 0047 0048 0049 0050 0051
 0052 0055 0056 0057 0060 0061 0077 0079 0107 0108 0109 0110 0209 0214 0215 0216 0217
 0218 0219 1001 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016
 1017 1018  1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1034 1035 1036 1037 1038 1039 1040);
```

Appendix C. Guam: A brief introduction

The island of Guam (located 13°26'40"N and 144°44'12"E) is the southernmost island of the Marianas Islands and has a population of 159,000 people. At 212 square miles, it is the largest of all the islands in Micronesia. Guam is an unincorporated territory of the United States by the 1950 Organic Act, so anyone born on Guam is granted U.S. citizenship. English and Chamorro are the two official languages; however, most business and commerce transactions are conducted in English.

Guam's economy depends heavily on tourism as its main source of income. Tourists are attracted not only to the beautiful beaches and tropical climate, but also to Guam's proximity to Asia in being the closest United States point of entry. Majority of Guam's tourists are from Japan, with many of the other tourists coming from other parts of Asia and Russia due to ease of access with visa waiver options offered to several countries in order to increase tourism on Guam.

Chamorros make up nearly 40% of the population and are the largest ethnic representation on Guam. The Chamorro people have a unique culture that is strongly rooted in the arts and ocean-related activities such as fishing and navigation. Spanish influences permeate much of the Chamorro culture and language due to initial Spaniard colonization from 1668-1898. Today, Guam is the most modernized island of the Micronesian islands. As development continues, the struggle grows stronger between the preservation of culture and modernization. Due to recent political and social changes on Guam, young adult Chamorros are taking proactive measures in bringing awareness to the current issues and striving towards rebirth of Chamorro traditions, language, and culture. It will be interesting to see what the future holds for Guam as the people continue to seek ways to be self-sufficient while co-existing with the U.S. military presence on the island.

Information and graphics courtesy of the *The World Factbook* in the Central Intelligence Agency's online library at www.cia.gov.

Appendix D. Sample FFQ

UNIVERSITY OF GUAM
UNIBETSEDÅT GUAHAN
Cancer Research Center

UNIVERSITY OF HAWAI'I
CANCER CENTER

Mariana Islands Food Intake Survey

Name: _____

Address: _____

_____

SUBJECT ID

TODAY'S DATE

Day	Month	Year

DATE OF BIRTH

Day	Month	Year

GENDER

- ○ Male
- ○ Female

ETHNIC BACKGROUND

- ○ Chamorro
- ○ Filipino
- ○ Micronesian (specify) _____
- ○ Other Pacific Islander (specify) _____
- ○ White/Caucasian
- ○ Native American
- ○ Asian (specify) _____
- ○ Black/African American
- ○ Hispanic

This survey is to be filled out **ONLY** by the person named above.

Mariana Islands Food Intake Survey

INSTRUCTIONS:

- Please use a black lead pencil to fill in the bubbles.
- Do **not** use a ball point pen.
- Please mark your response like this:

Please mark like this: ① ● ③ ④

- Bubbles must be completely shaded.
- Unless indicated, shade in only one bubble.

These questions are about your usual eating habits DURING THE LAST YEAR - this includes everything that you consumed during meals, snacks, at home, at work, in the car, eating out, etc. For each food group, please fill in the circle that best describes how often you ate those items and then fill in the circle that best describes your USUAL SERVING SIZE.

Most categories include examples. They are only suggestions, and you may not have eaten all of the listed items. Some ethnic foods are also listed. If you don't recognize the name, you probably don't eat that item.

For each item, please include any fresh, frozen, canned, and packaged foods you ate, such as TV dinners, frozen entrees, vegetables, or side dishes.

If you do not eat an item, or if you ate an item less than once a month, fill in the circle in the first column. DO NOT LEAVE BLANKS. It is not necessary to choose a serving size for these items.

Example: *This person ate a small bowl of cream of mushroom soup 2 to 3 times a month, and never ate dried bean or pea soup.*

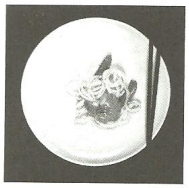
SOUPS AND NOODLES	AVERAGE USE DURING LAST YEAR (CHOOSE ONE)								YOUR USUAL SERVING SIZE
	Never or hardly ever	Once a month	2 to 3 times a month	Once a week	2 to 3 times a week	4 to 6 times a week	Once a day	2 or more times a day	
Cream Soups (such as chowder, cream of mushroom, cream of tomato)	○	○	●	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or less ● Small bowl (about 1 cup) ○ Large bowl (2 cups more)
Dried Bean or Pea Soup (such as lentil, mongo beans, split pea, black bean, Portuguese bean)	●	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or less ○ Small bowl (about 1 cup ○ Large bowl 2 cups more)

EXAMPLE ONLY

As you complete this questionnaire, please:

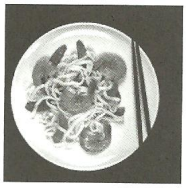
- **include FRESH, FROZEN, CANNED, FAST-FOOD, and PACKAGED food items,**
- **complete every line,**
- **make use of the pictures at the top of the page to help you estimate your USUAL SERVING SIZE,**
- **keep in mind that "1 cup" refers to an 8-ounce (240 ml) measuring cup.**

SOUPS AND NOODLES	AVERAGE USE DURING LAST YEAR (CHOOSE ONE)								YOUR USUAL SERVING SIZE
	Never or hardly ever	Once a month	2 to 3 times a month	Once a week	2 to 3 times a week	4 to 6 times a week	Once a day	2 or more times a day	
Cream Soups (such as chowder, cream of mushroom, cream of tomato)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or less ○ Small bowl (about 1 cup) ○ Large bowl (2 cups or more)
Dried Bean or Pea Soup (such as lentil, mongo beans, split pea, black bean, Portuguese bean)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or less ○ Small bowl (about 1 cup) ○ Large bowl (2 cups or more)
Ramen or Saimen (oriental noodles with broth)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or less ○ Small bowl (about 1 cup) ○ Large bowl (2 cups or more)
Broth with Rice or Noodles (such as arroz caldo, sotanghon, chicken noodle, chicken with rice, beef noodle)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or less ○ Small bowl (about 1 cup) ○ Large bowl (2 cups or more)
Meat Soup or Stew (such as Kadun beef shank, Kadun manok, kadan katne yan chotda, chalakiles, kare kare, chicken corn soup)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or less ○ Small bowl (about 1 cup) ○ Large bowl (2 cups or more)
Other Soups with Vegetables (such as chicken/beef vegetable, sinigang, minestrone, oxtail)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or less ○ Small bowl (about 1 cup) ○ Large bowl (2 cups or more)
Fried Noodle Dishes (such as pancit, pad thai, chow mein, yakisoba)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or less ○ Small bowl (about 1 cup) ○ Large bowl (2 cups or more)
Pasta with Tomato Sauce (such as spaghetti, lasagna, ravioli)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or less ○ Small bowl (about 1 cup) ○ Large bowl (2 cups or more)
Pasta with Cheese or Cream (such as macaroni and cheese, stroganoff, pasta with clam sauce)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or less ○ Small bowl (about 1 cup) ○ Large bowl (2 cups or more)
Potato or Macaroni Salad (with mayonnaise)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or less ○ Small bowl (about 1 cup) ○ Large bowl (2 cups or more)



A

B



C

MIXED DISHES	AVERAGE USE DURING LAST YEAR (CHOOSE ONE)								YOUR USUAL SERVING SIZE
	Never or hardly ever	Once a month	2 to 3 times a month	Once a week	2 to 3 times a week	4 to 6 times a week	Once a day	2 or more times a day	
Empanada, Lumpia, Pot Pie, or Turnover (with meat or poultry)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or 1 empanada ○ about 1 cup or 1 pie ○ 2 cups more
Beef or Pork Mixed with Vegetables (stir-fry, pinakbet, menudo, chop suey, chopsteak, beef broccoli, fajita)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1/2 cup or less) ○ Photo B (1 cup) ○ Photo C (2 cups more)
Chicken Mixed with Vegetables (such as stir-fry, chop suey, chicken a la king, fajita)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1/2 cup or less) ○ Photo B (1 cup) ○ Photo C (2 cups more)
Beef or Pork Cooked In Coconut Milk (such as tinaktak, chalakiles)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1/2 cup or less) ○ Photo B (1 cup) ○ Photo C (2 cups more)
Chicken or Fish Cooked in Coconut Milk (such as Kadun Guihan)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1/2 cup or less) ○ Photo B (1 cup) ○ Photo C (2 cups more)
Shrimp or Fish Mixed with Vegetables (such as eskabechi, stir-fry)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1/2 cup or less) ○ Photo B (1 cup) ○ Photo C (2 cups more)
Breakfast Sandwiches (such as sausage & biscuit, Egg McMuffin)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 sandwich or less ○ 2 sandwiches ○ 3 sandwiches or more
Sub Sandwiches (roast beef, turkey, chicken)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 sandwich or less ○ 2 sandwiches ○ 3 sandwiches or more
Hamburgers or Cheeseburgers (on a bun, includes fast-food burgers)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 regular size burger ○ 1 quarter-pound burger ○ 1 double burger or more
Pizza	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 piece/slice or less ○ 2 to 3 slices ○ 4 slices or more

A

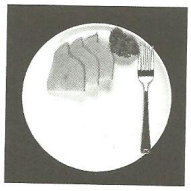
B

C

MEATS	AVERAGE USE DURING LAST YEAR (CHOOSE ONE)								YOUR USUAL SERVING SIZE
	Never or hardly ever	Once a month	2 to 3 times a month	Once a week	2 to 3 times a week	4 to 6 times a week	Once a day	2 or more times a day	
Meat Loaf, Meatballs, or Patties (not on a bun)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 to 2 meatballs ○ 1 patty or slice or 3 meatballs ○ 1 large patty or 5 meatballs
Beef, Lamb, or Veal (such as steak, roast, chuck, rib steak/ roast, shank, bistek, troson katne, beef kelaguen, teriyaki beef, pork adobo, carne asada)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 ounce or less ○ 3 oz. or 1 lamb chop ○ 5 ounces or more
Spareribs or Shortribs (such as BBQ, shortribs adobo)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 3 small or 1 long rib or less ○ 2 to 3 long ribs (5 to 7 inches) ○ 4 long ribs or more
Corned Beef (such as fresh, brisket, canned, corned beef and cabbage, hash)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1 oz. or 1/2 cup less) ○ Photo B (1/4 of 12oz. tin or 1 cup) ○ Photo C (1/2 of 12oz. tin or) 2 cups or more
Pork (such as chops, roast, shoulder char siu, roast/kalua pig, cutlet, belly carnitas, adobo, estufau)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1 ounce or less) ○ Photo B (3 ounces) ○ Photo C (5 ounces or more)
Ham (such as baked, fried, deli-style, or in sandwiches)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1 ounce or less) ○ Photo B (3 ounces) ○ Photo C (5 ounces or more)
Liver	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1 ounce or less) ○ Photo B (3 ounces) ○ Photo C (5 ounces or more)

HOW OFTEN DID YOU EAT YOUR MEAT, POULTRY, OR FISH PREPARED IN THE FOLLOWING WAYS...	AVERAGE USE DURING LAST YEAR (CHOOSE ONE)							
	Never or hardly ever	Once a month	2 to 3 times a month	Once a week	2 to 3 times a week	4 to 6 times a week	Once a day	2 or more times a day
Charcoal-broiled	○	○	○	○	○	○	○	○
Oven-broiled	○	○	○	○	○	○	○	○
Fried	○	○	○	○	○	○	○	○
Barbecued	○	○	○	○	○	○	○	○

A



B

C

POULTRY AND FISH	AVERAGE USE DURING LAST YEAR (CHOOSE ONE)								YOUR USUAL SERVING SIZE
	Never or hardly ever	Once a month	2 to 3 times a month	Once a week	2 to 3 times a week	4 to 6 times a week	Once a day	2 or more times a day	
Fried Chicken (such as wings, patties, fried chicken sandwiches, chicken katsu, fast-food chicken strips, nuggets, fried cutlet)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1 drumstick) ○ Photo B (1 breast, 2 thighs, 3 wings, or 1 patty) ○ Photo C (2 breasts or 4 thighs)
BBQ Chicken	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1 drumstick) ○ Photo B (1 breast, 2 thighs, 3 wings, or 1 patty) ○ Photo C (2 breasts or 4 thighs)
Roasted, Baked, Grilled, or stewed chicken (such as ground, in sandwiches, adobo, estufau, kadun pika, teriyaki, cornish hen)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1 drumstick) ○ Photo B (1 breast, 2 thighs, 3 wings, or 1 patty) ○ Photo C (2 breasts or 4 thighs)
Chicken Kelaguen	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1 ounce or less) ○ Photo B (3 ounces) ○ Photo C (5 ounces or more)
Turkey (such as roast, ground, deli-style, in sandwiches)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1 ounce or less) ○ Photo B (3 ounces) ○ Photo C (5 ounces or more)
Fried Shrimp or Other Shellfish (such as tempura, bunelos uhang, calamari, squid)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 to 3 items ○ 4 to 5 items or 1/2 cup ○ 6 items or more
Cooked, Canned, Raw, or Imitation Shellfish (such as shrimp, crab, octopus, squid, mussels, clams, sea snail)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 5-6 shrimps or 1/4 cup or less ○ 1 crab or 1/2 cup ○ 1 lobster tail or 1 cup or more
Shrimp Kelaguen (such as kelaguen uhang)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1 ounce or less) ○ Photo B (3 ounces) ○ Photo C (5 ounces or more)
Fried Fish (such as pan-fried, fish cake, shrimp patty, fish sticks, in sandwiches)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1 ounce or less) ○ Photo B (3 ounces) ○ Photo C (5 ounces or more)
Fish, Baked, Broiled, Boiled, Raw, Kelaguen (such as tuna, ahi, aku, mahimahi, wahoo, salmon cod, tilapia, milkfish, paksiw, mackerel, relyeno)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1 ounce or less) ○ Photo B (3 ounces) ○ Photo C (5 ounces or more)

POULTRY AND FISH (continued)	AVERAGE USE DURING LAST YEAR (CHOOSE ONE)								YOUR USUAL SERVING SIZE
	Never or hardly ever	Once a month	2 to 3 times a month	Once a week	2 to 3 times a week	4 to 6 times a week	Once a day	2 or more times a day	
Canned Tunafish (plain, salad, in sandwiches)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/4 cup or 1/2 sandwich ○ 1/2 cup or 1 sandwich ○ 1 cup or 1can (6oz) or more
Other canned fish (such as salmon, sardines, mackerel, salmon finadeni)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 3 small sardines or 1/4 cup ○ 1/2 cup ○ 1 cup or more
Salted and Dried Fish or Shellfish (such as shrimp, cuttlefish, anchovies, iriko, taegu)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 slice or strip/piece ○ 2 slices ○ 4 slices or more

MORE MEATS AND MIXED DISHES	AVERAGE USE DURING LAST YEAR (CHOOSE ONE)								YOUR USUAL SERVING SIZE
	Never or hardly ever	Once a month	2 to 3 times a month	Once a week	2 to 3 times a week	4 to 6 times a week	Once a day	2 or more times a day	
Bacon (such as pork, turkey bacon, Canadian bacon)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 slice or strip/piece ○ 2 slices ○ 3 slices or more
Hot Dogs (beef, pork, turkey, chicken)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 hot dog ○ 1 hot dog ○ 2 hot dogs or more
Spam, Bologna, Salami, Pastrami, or Other Luncheon Meat (includes Spam kelaguen)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 slice (1 ounce or less) ○ 2 slices ○ 3 slices or more
Sausage (such as pork, beef, Portuguese, Vienna, Polish, hot links, chorizo)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 piece or link ○ 2-3 pieces or links or 1 patty ○ 3 slices or more
Tacos, Burritos, Tostadas, Sopes, or Taco Salad (with beef, chicken, or pork)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 item or 1 cup salad or less ○ 2 items or 2 cup salads ○ 3 items or 3 cups salad or more
Vegetable or Bean Burritos, Tacos, or Tostadas (no meat)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 item or less ○ 2 items ○ 3 items or more

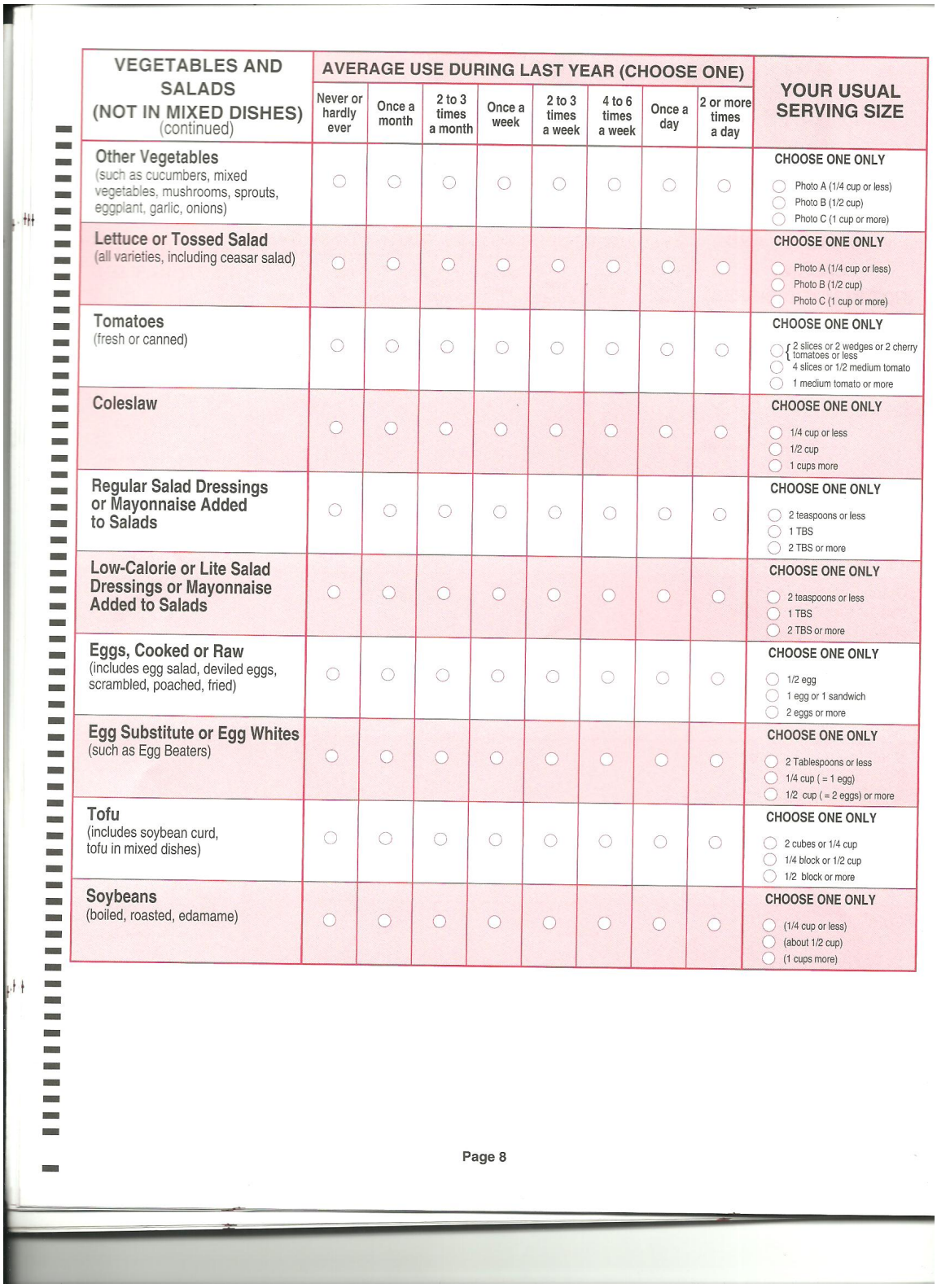
STARCHES	AVERAGE USE DURING LAST YEAR (CHOOSE ONE)								YOUR USUAL SERVING SIZE
	Never or hardly ever	Once a month	2 to 3 times a month	Once a week	2 to 3 times a week	4 to 6 times a week	Once a day	2 or more times a day	
White Rice	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or 1 scoop or less ○ 1 rice bowl (1cup) or 1 musubi ○ 2 rice bowls (2 cups) or 2 musubi or more
Fried Rice	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or less ○ 1 cup ○ 2 cups or more
Red Rice (made with achote)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or 1 scoop or less ○ 1 cup or 2 scoops ○ 2 cups or more
Brown or Wild Rice	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or 1 scoop or less ○ 1 cup or 2 scoops ○ 2 cups or more
Sushi (includes Chamorro sushi, Spam musubi)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 to 2 pieces or 1 small cone ○ 3 to 4 pieces or 1 large cone or 1\2 cup ○ 5 pieces or 1 cup or more
French-Fries, Hash-Browned or Other Fried Potatoes	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 small order or 1 patty or 1 cup ○ 1 medium order or 2 patties ○ 1 large order or 3 patties or more
Baked or Boiled Potatoes	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 small or 1/2 medium or less ○ 1 medium (5 inches) ○ 1 large or more
Sweet Potatoes or Yams (includes gollai appan dagu)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 small or 1/2 medium or less ○ 1 medium (5 inches) ○ 1 large or more
Breadfruit	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/4 breadfruit or less ○ 1/2 breadfruit ○ 1 whole breadfruit or more
Taro	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/4 taro or less ○ 1/2 taro ○ 1 whole taro or more

A

B

C

VEGETABLES AND SALADS (NOT IN MIXED DISHES)	AVERAGE USE DURING LAST YEAR (CHOOSE ONE)								YOUR USUAL SERVING SIZE
	Never or hardly ever	Once a month	2 to 3 times a month	Once a week	2 to 3 times a week	4 to 6 times a week	Once a day	2 or more times a day	
Broccoli (raw or cooked)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1/4 cup or less) ○ Photo B (1/2 cup) ○ Photo C (1 cup or more)
Cabbage (such as head, Chinese or Napa cabbage, kim chee, Brussel sprouts)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1/4 cup or less) ○ Photo B (1/2 cup) ○ Photo C (1 cup or more)
Dark Leafy Greens (such as gollai hagun suni (taro leaves), spinach, bok choy, collard greens, watercress, choi sum, chard, pumpkin tips, gollai puntan kalamasa)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1/4 cup or less) ○ Photo B (1/2 cup) ○ Photo C (1 cup or more)
Green Beans or Peas (includes string beans, long beans, peapods)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1/4 cup or less) ○ Photo B (1/2 cup) ○ Photo C (1 cup or more)
Other Green Vegetables (such as celery, green peppers, asparagus, bittermelon)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1/4 cup or less) ○ Photo B (1/2 cup) ○ Photo C (1 cup or more)
Cauliflower or Broccoflower	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1/4 cup or less) ○ Photo B (1/2 cup) ○ Photo C (1 cup or more)
Carrots (raw or cooked)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1/4 cup or less) ○ Photo B (1/2 cup) ○ Photo C (1 cup or more)
Corn (fresh, frozen, or canned)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1/4 cup or less) ○ Photo B (1/2 cup) ○ Photo C (1 cup or more)
Pumpkin or Yellow-Orange Winter Squash	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1/4 cup or less) ○ Photo B (1/2 cup) ○ Photo C (1 cup or more)
Red or Orange Bell Peppers	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1/4 cup or less) ○ Photo B (1/2 cup) ○ Photo C (1 cup or more)



VEGETABLES AND SALADS (NOT IN MIXED DISHES) (continued)	AVERAGE USE DURING LAST YEAR (CHOOSE ONE)								YOUR USUAL SERVING SIZE
	Never or hardly ever	Once a month	2 to 3 times a month	Once a week	2 to 3 times a week	4 to 6 times a week	Once a day	2 or more times a day	
Other Vegetables (such as cucumbers, mixed vegetables, mushrooms, sprouts, eggplant, garlic, onions)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1/4 cup or less) ○ Photo B (1/2 cup) ○ Photo C (1 cup or more)
Lettuce or Tossed Salad (all varieties, including ceasar salad)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Photo A (1/4 cup or less) ○ Photo B (1/2 cup) ○ Photo C (1 cup or more)
Tomatoes (fresh or canned)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 2 slices or 2 wedges or 2 cherry tomatoes or less ○ 4 slices or 1/2 medium tomato ○ 1 medium tomato or more
Coleslaw	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/4 cup or less ○ 1/2 cup ○ 1 cups more
Regular Salad Dressings or Mayonnaise Added to Salads	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 2 teaspoons or less ○ 1 TBS ○ 2 TBS or more
Low-Calorie or Lite Salad Dressings or Mayonnaise Added to Salads	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 2 teaspoons or less ○ 1 TBS ○ 2 TBS or more
Eggs, Cooked or Raw (includes egg salad, deviled eggs, scrambled, poached, fried)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 egg ○ 1 egg or 1 sandwich ○ 2 eggs or more
Egg Substitute or Egg Whites (such as Egg Beaters)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 2 Tablespoons or less ○ 1/4 cup (= 1 egg) ○ 1/2 cup (= 2 eggs) or more
Tofu (includes soybean curd, tofu in mixed dishes)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 2 cubes or 1/4 cup ○ 1/4 block or 1/2 cup ○ 1/2 block or more
Soybeans (boiled, roasted, edamame)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ (1/4 cup or less) ○ (about 1/2 cup) ○ (1 cups more)

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BEANS (NOT IN SOUPS OR MIXED DISHES)	AVERAGE USE DURING LAST YEAR (CHOOSE ONE)								YOUR USUAL SERVING SIZE
	Never or hardly ever	Once a month	2 to 3 times a month	Once a week	2 to 3 times a week	4 to 6 times a week	Once a day	2 or more times a day	
Refried Beans (not in burritos or tostadas)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/4 cup or less ○ about 1/2 cup ○ 1 cup or more
Baked Beans or Pork and Beans	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/4 cup or less ○ about 1/2 cup ○ 1 cup or more
Boiled Beans or Peas (such as pinto, kidney, black beans, lima, black-eyed peas)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/4 cup or less ○ about 1/2 cup ○ 1 cup or more

FRUIT	AVERAGE USE DURING LAST YEAR (CHOOSE ONE)								YOUR USUAL SERVING SIZE
	Never or hardly ever	Once a month	2 to 3 times a month	Once a week	2 to 3 times a week	4 to 6 times a week	Once a day	2 or more times a day	
Oranges (excluding juices, includes tangerines, mandarin oranges)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 orange or 1 tangerine or 1/2 cup or less ○ 1 orange or 2 tangerines or 1 cup ○ 2 orange or 3 tangerines or more
Grapefruit or Pomelo (excluding juice)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/4 cup or less ○ 1/2 grapefruit or 1/2 cup ○ 1 cup or more
Ripe Papaya	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or 1/4 small papaya or less ○ 1 cup or 1/2 small papaya ○ 2 cups or 1 small papaya or more
Green Papaya (includes pickled papaya)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or 1/4 small papaya or less ○ 1 cup or 1/2 small papaya ○ 2 cups or 1 small papaya or more
Peaches and Apricots (fresh, canned, or dried; excluding juice)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 peach or 1 apricot or less ○ 1 peach or 2 apricots or 1/2 cup ○ 2 peaches or 3 apricot or 1 cup or more
Apples and Pears (fresh, canned, or dried; excluding juice)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 pear or apple or 1/2 cup or less ○ 1 pear or apple or 1 cup ○ 2 pears or apples or more
Bananas	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 banana or less ○ 1 banana or (8 inch) ○ 2 bananas or more

FRUIT (continued)	AVERAGE USE DURING LAST YEAR (CHOOSE ONE)								YOUR USUAL SERVING SIZE
	Never or hardly ever	Once a month	2 to 3 times a month	Once a week	2 to 3 times a week	4 to 6 times a week	Once a day	2 or more times a day	
Melons (including cantaloupe, watermelon, honeydew)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/4 cantaloupe or 1 quarter slice or 1/2 cup or less ○ 1/2 cantaloupe or 1 half slice or 1 cup ○ 1 cantaloupe or 1 whole slice or more
Ripe Mango (fresh or dried)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup slices or less ○ 1 medium or 1 cup ○ 1 large Hayden or more
Green Mango (includes pickled mango)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup slices or less ○ 1 medium or 1 cup ○ 1 large Hayden or more
Avocados and Guacamole	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 2 slices or 2 TBS ○ 1/4 avocado or 1/4 cup ○ 1/2 avocado or 1/2 cup or more
Other Fruits (fresh, canned, or dried) (such as grapes, raisins, pineapple, berries, nectarines, soursop, breadfruit)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or less ○ 1 cup ○ 2 cups or more
Orange or Grapefruit Juice (not orange drink or orange soda)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Small juice glass (1/2 cup) ○ Large glass (8oz) ○ 12-ounce can or more
Tomato or V-8 Vegetable Juice	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Small juice glass (1/2 cup) ○ Large glass (8oz) ○ 12-ounce can or more
Blended Fruit Drinks (such as smoothies)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Small juice glass (1/2 cup) ○ Large glass (8oz) ○ 12-ounce can or more
Other Fruit Juices (such as apple juice, grape juice)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Small juice glass (1/2 cup) ○ Large glass (8oz) ○ 12-ounce can or more

BREADS AND SPREADS	AVERAGE USE DURING LAST YEAR (CHOOSE ONE)								YOUR USUAL SERVING SIZE
	Never or hardly ever	Once a month	2 to 3 times a month	Once a week	2 to 3 times a week	4 to 6 times a week	Once a day	2 or more times a day	
White Bread (such as pan dulce, pita, breadsticks, French, sandwiches)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 slice or less ○ 2 slices ○ 3 slices or more
Whole Wheat or Rye Bread (such as pumpernickel, bran, whole wheat pita, in sandwiches)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 slice or less ○ 2 slices ○ 3 slices or more
Buns, Rolls, and Biscuits (includes bagels, English muffins, hamburger/hotdog buns, dinner rolls)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 of a 3 inch item ○ 1 item (3 inch) ○ 1 large bagel or 2 items (3 inch) or more
Flour Tortillas (tatiyas mai'es)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 tortilla ○ 2 tortillas ○ 3 tortillas or more
Corn Tortillas (includes tatiyas harina, tatiyas mames, bibingka)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 tortilla ○ 2 tortillas ○ 3 tortillas or more
Doughnuts, Sweet Rolls, Danish Pastries, Croissants, or Scones (includes bunelos, banana lumpia)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 item or less ○ 2 items ○ 3 items or more
Pancakes, Waffles or French Toast	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 item or less ○ 2 items ○ 3 items or more
Margarine Added to Bread Items	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Spread thin ○ Spread thick
Butter Added to Bread Items	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Spread thin ○ Spread thick
Peanut Butter Added to Bread Items	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Spread thin ○ Spread thick
Jam or Jelly Added to Bread Items	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Spread thin ○ Spread thick
Mayonnaise in Sandwiches	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ Spread thin ○ Spread thick

CEREAL AND DAIRY	AVERAGE USE DURING LAST YEAR (CHOOSE ONE)								YOUR USUAL SERVING SIZE
	Never or hardly ever	Once a month	2 to 3 times a month	Once a week	2 to 3 times a week	4 to 6 times a week	Once a day	2 or more times a day	
Dry Cereals (such as corn flakes, Cheerios, granola, Chex, Special K)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or less ○ 1 cup or individual box ○ 1-1/2 cups or more
Cooked Cereals (such as oatmeal, cream of wheat, corn grits)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or less ○ 1 cup or individual box ○ 1-1/2 cups or more
Whole Milk (as beverage or added to cereal; includes chocolate milk)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or less ○ 1 cup or 1/2 pint ○ 2 cups or more
Lowfat Milk (2% or 1%) (as beverage or added to cereal, includes lactose reduced, acidophilus; includes chocolate milk)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or less ○ 1 cup or 1/2 pint ○ 2 cups or more
Nonfat or Skim Milk (as beverage or added to cereal, includes lactose reduced, acidophilus)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or less ○ 1 cup or 1/2 pint ○ 2 cups or more
Soy Milk (as beverage or added to cereal)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or less ○ 1 cup or 1/2 pint ○ 2 cups or more
Yogurt (includes lowfat and nonfat)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 cup or less ○ 1 cup or 1/2 pint ○ 2 cups or more
Cheese (such as American, cheddar, Swiss, Parmesan, lowfat cheeses)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 slice or 1 TBS ○ 1 slice (1 oz) ○ 2 slices (2 oz) or more

DESSERTS AND SNACKS	AVERAGE USE DURING LAST YEAR (CHOOSE ONE)								YOUR USUAL SERVING SIZE
	Never or hardly ever	Once a month	2 to 3 times a month	Once a week	2 to 3 times a week	4 to 6 times a week	Once a day	2 or more times a day	
Ice Cream, Ice Milk, Frozen Yogurt, or Sherbet	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1scoop (1/2 cup) or less ○ 2 scoops (1 cup) or 1 bar ○ 3-4 scoops (1 pint) or more
Cookies or Brownies (includes fruit cookies, wafers, biscotti, macaroons, uraro, guzuria, polvoron)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1-2 average size cookies ○ 3-4 average or 1 extra large cookie or 1 brownie or fruit bar ○ 2 large cookies or brownies or more
Cake Cake (includes latiya, velvet, sponge, cassava, potu, tamales gisu, tamales suni)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 small piece or cupcake ○ 1 average piece (1/12 of a cake) ○ 2 pieces or more
Pies, Tarts, Cobblers, or Turnovers (includes buchi buchi, pastit)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 small piece ○ 1 piece (1/8 pie) or 1 item ○ 1/6 pie or more
Puddings or Custards (includes leche flan, champulado, ahu, kalamai, apigigi)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 small piece or snack size or 1/2 cup ○ 1 average piece or 2 snack size or 1 cup or item ○ 1/6 pie or 1-1/2 cups or more
Chocolate Candy or Bars	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1-3 pieces or less ○ 1 regular size bar ○ 1 giant-size bar or more
Crackers and Pretzels (such as biscuchu, saltines, soda, graham, Wheat Thins, Japanese rice crackers)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 4-5 snack or 1 large cracker ○ 6-10 snack or 2 large crackers ○ 3 large crackers or more
Peanuts or Other Nuts (includes trail mix)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 12 nuts or less ○ 1/4 cup ○ 1/2 cup or more
Chips (such as potato, tortilla, corn, Doritos, pork rinds)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 snack bag or 1/2 cup ○ 1-ounce bag (1cup) ○ 1/2 twin-pack or more
Popcorn	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1-3 cups or less ○ 1 microwave bag ○ 1 medium theater tub or more

BEVERAGES	AVERAGE USE DURING LAST YEAR (CHOOSE ONE)								YOUR USUAL SERVING SIZE
	Never or hardly ever	Once a month	2 to 3 times a month	Once a week	2 to 3 times a week	4 to 6 times a week	Once a day	2 or more times a day	
Regular or Draft Beer	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 can or bottle or less OR ○ 2 cans or bottles OR ○ 3 to 4 cans or bottles OR ○ 5 cans or bottles or more
Light Beer	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 can or bottle or less OR ○ 2 cans or bottles OR ○ 3 to 4 cans or bottles OR ○ 5 cans or bottles or more
White or Pink Wine (includes champagne, tuba, sake)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 glass or less OR ○ 2 glasses OR ○ 3 to 4 glasses OR ○ 5 glasses or more
Red Wine	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 glass or less OR ○ 2 glasses OR ○ 3 to 4 glasses OR ○ 5 glasses or more
Hard Liquor (such as gin, rum, vodka, bourbon, scotch, tequila, liqueurs, cocktails)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1 drink or less OR ○ 2 drinks OR ○ 3 to 4 drinks OR ○ 5 drinks or more
Sweetened Beverages (includes sodas, tea, Tang, fruit punch, Koolaid, fruit drinks, lemonade, Red Bull, cranberry juice cocktail, Gatorade)	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 can or small glass OR ○ 1 can or large glass OR ○ 2 to 3 cans or glasses OR ○ 4 cans or glasses or more
Diet Sodas	○	○	○	○	○	○	○	○	CHOOSE ONE ONLY ○ 1/2 can or small glass OR ○ 1 can or large glass OR ○ 2 to 3 cans or glasses OR ○ 4 cans or glasses or more

BEVERAGES	AVERAGE USE DURING LAST YEAR (CHOOSE ONE)								WHAT DID YOU USUALLY ADD?
	Never or hardly ever	Once a month	2 to 3 times a month	Once a week	2 to 3 times a week	4 to 6 times a week	Once a day	2 or more times a day	
Cappuccino - 1 cup or mug (includes café au lait, café latte, café con leche)	○	○	○	○	○	○	○	○	MARK ALL THAT APPLY ○ Sugar or Honey ○ Sugar substitute
Regular Coffee - 1 cup or mug (brewed or instant)	○	○	○	○	○	○	○	○	MARK ALL THAT APPLY ○ Cream or half & half ○ Milk ○ Non-dairy cream ○ Sugar or Honey ○ Sugar substitute
Decaffeinated ("Decaf") Coffee - 1 cup or mug (brewed or instant)	○	○	○	○	○	○	○	○	MARK ALL THAT APPLY ○ Cream or half & half ○ Milk ○ Non-dairy cream ○ Sugar or Honey ○ Sugar substitute
Black Tea (unsweetened) - 1 cup or glass (such as Lipton's, oolong, iced tea)	○	○	○	○	○	○	○	○	MARK ALL THAT APPLY ○ Cream or half & half ○ Milk ○ Non-dairy cream ○ Sugar or Honey ○ Sugar substitute
Green Tea (unsweetened) - 1 cup	○	○	○	○	○	○	○	○	MARK ALL THAT APPLY ○ Cream or half & half ○ Milk ○ Non-dairy cream ○ Sugar or Honey ○ Sugar substitute
Herbal or Other Tea (unsweetened) - 1 cup	○	○	○	○	○	○	○	○	MARK ALL THAT APPLY ○ Cream or half & half ○ Milk ○ Non-dairy cream ○ Sugar or Honey ○ Sugar substitute

How many glasses of plain water (tap or bottled) did you usually drink in a day?

none ○ 1 - 2 ○ 3 - 4 ○ 5 - 6 ○ 7 - 9 ○ 10 or more ○